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THE demand for the present work having been greater than was anticipated, a Second Edition has been called for, before the Author, whose time is otherwise wholly engrossed, could find leisure to render it more perfect. It is therefore an exact reprint from the First Edition, and as there has been but one opinion of the usefulness of the book, it is hoped the present edition will be as favourably received as was the first, despite its imperfections.

J. R. J.

PREFACE.

THE object of the present work is simply, as its title indicates, to point out to the uninitiated traveller what he should observe, and to remind the one who is well informed, of many objects which, but for a remembrancer, might escape him.

In the execution of our task we have not confined ourselves to a mere list of questions, but have endeavoured to excite a desire for useful knowledge by awakening curiosity. The intending traveller, it is hoped, will, from a perusal of the present work, see what an immense field of physical and moral research lies open to his investigation, and be encouraged to exertion by the assurance that, without being what is termed a philosopher, he may not only do much to enlarge the sphere of his own ideas, but acquire the means of communicating to others a great mass of valuable or interesting information.

We are fully sensible that our labour is yet very imperfect, and, under this impression, would not have

presumed to bring it before the public did we not feel confident that, imperfect as it may be, it will still be useful: indeed, when we consider the total absence of anything like solid information given to us by the legion of those who quit their native country to roam for a while over the various parts of the globe, we cannot but think that some good must result from pointing out how their peregrinations may be turned to better account than they have hitherto been.

Our book is intended for general use, and we therefore hope it will prove acceptable alike to those who travel luxuriously over civilized Europe, and to those adventurous and ardent spirits who wander undaunted among hostile tribes, braving every obstacle and enduring every hardship in search of knowledge.

It were superfluous to speak of the present facilities for travelling, but we will remark that, in proportion as those facilities are great, the result should be beneficial, and this it will be, (as far as regards a true knowledge of the earth and of the various families of mankind, with their laws, religion, manners, customs, virtues and vices,) only when travellers shall have learnt how and what to observe.

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DIVISION I.

OF A COUNTRY CONSIDERED IN ITSELF.

SECTION I.

GEOGRAPHICAL POSITION.—What are the degrees of longitude and latitude between which the country* is contained?

What are its boundaries, and the names of the countries or seas on its confines, with the length and direction of the several frontier lines? Is the boundary merely conventional and political, or is it natural, such as that formed by the sea, by large rivers, chains of mountains, impassable swamps, &c.?

What is the whole length of the frontier line in following all its bends?

What is the greatest, the least, and the medium length and breadth of the country, and

Its surface in square miles of sixty to the degree?

If the country has been very anciently described, the traveller will do well to compare its actual geography with the old descriptions. This is what is termed *Comparative Geography:* in order to succeed in which, it is necessary to begin by carefully extracting all that ancient geographers may have written about the country in question: and to avoid misconstruction, it is very desirable that the language in which they wrote should be thoroughly understood, for translations are often erroneous, and, when so, occasion fruitless research, and lead to incorrect results. The various extracts made, the respective importance to be attached to them, will of course depend upon the confidence to which the several writers are entitled. The next step is the ex-

* This expression, *the country*, will frequently occur, and whenever it does, it means the particular country under examination.

amination of the places themselves, which will either corroborate the descriptions already given, detect the errors which may have been made, or show the physical changes which have taken place.

The study of the manners and customs of the ancient inhabitants, as also that of the monuments they have left, will be found of great importance to comparative geography.

DIVISIONS OF THE COUNTRY.—Countries are sometimes divided into high and low lands; or into states or portions, as northern, southern, eastern, western, and central states; sometimes into ranges, as the sandy, the forest, the swampy range, &c. When a country borders on the sea, those provinces which are bathed by its waters, are called the maritime provinces, while the others are termed the inland provinces, and occasionally, as in America, the back settlements.

A division particularly advantageous in many respects is that into basins, designated specifically by the names of the rivers which flow through them. A principal basin, is that through which a principal river, or river of the first order flows. A basin of the second order, is that of a secondary river, and so forth. We sometimes speak of the upper or superior, and of the lower basin, by which is understood the upper or lower portions of the same great basin. Further, a principal basin is sometimes divided into several minor basins; as is the case with the great basin of the Danube, which is divided into four partial basins, known as first, second, &c.

The political divisions of a country are extremely arbitrary, and have different names, as Governments, States, Provinces, Counties, Districts, Circles, Departments, Cantons, Parishes, &c.

Whenever we would speak of the productions of a country, we should choose a *natural* division; and in so doing, that must be preferred which bears the most immediate relation to our particular object. Thus the geologist will speak of Regions, of Formations, of Districts, of Chains, &c.; the hydrographer, of Basins; the naturalist will divide the country into climates, deduced either from the height above the level of the sea, from aspect, from latitude and longitude, &c., or from several of these circumstances combined. In speaking of the administration of a country, its population, its commerce, its manufactures, &c., the political divisions must be observed. If the country be considered

with relation to its history, its manners, its customs, its laws, &c., it will be well to distinguish the more lately acquired from the older provinces.

To all these different objects should be added, a detail of those successive aggrandizements and dismemberments of territory, which constitute what may be termed the territorial history of the country.

GENERAL ASPECT OF THE COUNTRY.—The different revolutions of the earth have given rise to irregularities on its surface, which procure to us a thousand advantages that we should be without, were the surface even. They give variety of aspect to different countries, and produce infinite modifications of local climate.

The influence of locality has been recognised from the earliest times; and Hippocrates, who has gone into great detail on the subject, attributes to it an importance which, although exaggerated, is, in fact, too real to be doubted. It is admitted by physiologists in general; and Montesquieu has shewn, with his accustomed sagacity, how important it is to attend to the influence of climate in the framing of laws. Now the aspect of a country is not only the general expression of its climate, but makes known, at the same time, the causes and effects of this climate. Thus it is easy to see how important it is to detail the aspect of a country in every good description. The variety of sites; the configuration and direction of the valleys and the hills; the state and kind of vegetation, with its greater or less abundance; or the general nudity of the country; the general quality of the soil; the extent and distribution of its waters, &c., must all be carefully noted. Travellers should, nevertheless, be cautious how they generalize in speaking of the aspect of a country; for the parts they have not seen may be very different from those they have visited; and the same places present very different appearances at different seasons.

The aspect alone of a country, or part of a country, will not, however, satisfy the scientific traveller; the knowledge it furnishes is not sufficiently precise; but it will greatly assist him in acquiring a knowledge of the true nature of the climate and soil, which can only be done by the consideration of the aspect, together with all the other circumstances connected with the subject, which he shall have observed in the course of his journeys over different parts. The more varied and multiplied his tracks over the country, and the more he shall have considered the same places

at different seasons, so much the better will he be enabled to combine causes and effects, and satisfy his mind regarding both. Thus from his partial observation of the individual features of the country, and their co-relation, he will deduce its general physiognomy; and from the combination of details he will work out a general result. But it being evident that a difference in the details will produce a corresponding difference in the results, his conclusions will be correct only in proportion to the care he shall have taken to let no influential circumstance escape his notice.

To see that the general aspect of a country is mountainous will not alone authorize the traveller to draw particular conclusions; the same may be said of forests, &c. The effect of mountains on local climate will be very different according to the direction, height, continuity, and nature of the chain. The effects of forests are also very different according as they are of deciduous trees or evergreens, as they are situated in the plains or on the sides of the hills, &c.

The general aspect of a country, as regards fertility, may be very different from what the immediate conformation of the surface would lead the traveller to expect; in which case, absolute height above the level of the sea, exposure to certain winds, &c., are the cause of anomaly. Hence the aspect of a country must be noticed by the traveller as he proceeds, and every feature must be attentively examined; but it is only after he has completed his researches and observations, that he can give satisfactory reasons for the general physiognomy and climate of the country. But we must enter into more details.

SUPERFICIAL CONFIGURATION.—*Of Mountains and Valleys.*—The terms used in physical geography (of which geology is a branch) are so extremely vague, that we hardly know what precise idea to attach to any one of them; thus the difference between a high hill and an insignificant mountain is difficult to determine, and the same eminence may receive both names. We must, therefore, leave to the judgment of the traveller to call the elevations he meets with by the terms he thinks most appropriate. We use the term Mountain in its generally received acceptation.

Wherever there are mountains there are valleys; the two must, therefore, be treated in connexion.

If we consider the whole surface of the globe, we find certain extensive and lofty ranges of mountains; these not

unfrequently send off other ranges of less extent and height, from which others again branch out. These several chains diminish gradually in height, with occasional exceptions, till at length the mountains sink into hills, continually diminishing in elevation till they are confounded in the gentle undulations of the plains, or finally subside into a horizontal surface. If, however, we limit our observations to some particular country we are apt to regard the largest range of mountains which intersect it, as a chain of the first order, while in reality it may be but of the second or third order, as regards the general system of mountains of the earth. The traveller will pay due attention to this, in order not to use terms which may lead to false conceptions.

The term chain, as applied to elevations on the earth's surface, has been variously defined, and is extremely vague. We understand by it a succession or range of hills and mountains, forming a band whose breadth is little or nothing compared with its length. Thus, a line of hills, a mile in length, if only a few hundred feet in breadth, is as much a chain as the Andes, whose breadth in some places, is 120 miles, but which extend in an uninterrupted line through the whole of South America.

In large chains, the mountains are in some parts connected from base to summit, forming a continuous ridge, or, to speak more correctly, perhaps, some parts of the chain are formed of one long narrow mountain, shaped somewhat like the roof of a house; in other places, the chain is formed of mountains grouped together without order, but connected by their bases, and for a great way up, after which they divide into separate mountains; sometimes the chain splits, as it were, into two or more ridges, which either diverge considerably from the main chain, or run nearly parallel with it; in both cases they are regarded as distinct chains; sometimes they inosculate or re-unite to the main chain, in which case they may or may not be regarded as part of the same chain.

The spaces contained between chains are very arbitrarily called Valleys, or Basins, or Plains. Those which lie between parallel ridges, running in the direction of the main chain, are termed Longitudinal Valleys, while those which lie between chains of the second order are Transversal, and those between chains of the third order, are termed Lateral Valleys. The transversal or principal valleys, or valleys of the first order, have their direction more or less perpendicular to the axis

of a chain of the first order; through these flow the principal rivers of a continent. These valleys are met by the lateral valleys on either side; and they themselves open out and are confounded with the lower plains or champaign country. The land which lies between inosculating branches is generally very high, as compared with the plains beyond the chain on either side, and are, if very extensive, called Table-lands, or Plateau. Such are the table-lands of Quito, the great plateau of Central Asia, &c. When smaller, they are included in what are termed the higher or Mountain Valleys. All table-lands, however, are not hemmed in by mountains whose summits rise above the level of the table-land; they sometimes rise from the plains abruptly like terraces, being themselves, as it were, the flat summits or horizontal sections of huge mountains. Sometimes again, the table-land is ascended by gentle acclivities without having anything like mountains near them, and sometimes again they rise by steps, or successive and retiring terraces. Chains of mountains or hills sometimes diverge from a common centre, which is generally the highest point; and of such chains, it is frequently hard to determine which is the principal. Sometimes a number of chains run parallel to, but have no connexion with each other, or with any main trunk; and sometimes the mountains of a country present no appearance whatever of a chain, but are heaped together in confused groups without any order. In some places, mountains are seen to rise in isolated masses from a plain, otherwise level; such are frequently volcanic.

It is observed in chains, that the points from which other chains or ridges diverge, are more elevated than other parts of the chain, so that between any two contiguous elevations of this kind, the ridge or summit line of the chain is inflected. These inflections form the points of easiest passage from one side of the chain to the other; and over them, accordingly, the roads are generally constructed. They are called the *Passes*, and differ from defiles, which are either narrow ravines, winding through the mountains, or chasms intersecting any part of them.

A *Gorge* is the narrowest part of a large valley; or a short and very steep valley is sometimes so called.

There is sometimes observed, in the form of longitudinal valleys, such a perfect correspondence between the salient angles of one side, and the re-entering angles of the other, that if the two ridges could be brought together, no trace

of the openings would remain, a circumstance which has been construed into a proof that such valleys have been formed by some convulsion of nature.

The summit line of chains, or parts of chains, is either nearly horizontal, and presents a surface of greater or less width, in which latter case roads sometimes pass along it, or, what we more frequently find, it is rugged and broken, presenting at a distance sharp pinnacles, or cones, or domes, or walls, according to the particular nature of the rocks, which these forms, in some cases, indicate with considerable certainty. A similar difference of outline is observed in mountains irregularly grouped; as also in those that are isolated.

It is observed, generally, that mountains are much more steep on one side than on the other; but of this we shall treat more at large, under the head *Slope*.

With regard to Plains, they are no better defined than Mountains. Their name would induce us to believe that their surface is horizontal, or at least even; but this is far from being always the case, as we shall presently see.

The best idea, perhaps, we can have of the regularity or the earth's surface is to conceive, first, a general surface, formed of plains or facets of different extent, and variously inclined to each other. Above the level of this surface, are various acclivities of different height and form, and variously grouped; these are the hills and mountains; while below the general level, we find hollows, also differing in form and dimensions, which are the *Valleys of the plains*.

Having thus sketched a brief outline of the superficial irregularities of the earth's crust, we proceed to the particular observations to be made.

MOUNTAINS.—*Name.*—With regard to the names of mountains, generally and particularly, nothing can well be more arbitrary. Thus, a long chain has often different names in different parts; while, on the other hand, many different and distinct summits are considered as one mountain, and have but one name. As most mountains, and chains of mountains, however, are already named, the traveller will have no other difficulty, perhaps, in this respect, than that of determining sometimes the precise limits of parts bearing different appellations. In cases of countries little known, it is customary for the first explorer to christen the several mountains or chains, or to adopt native names, when such exist. And here we cannot avoid counselling the traveller to adopt the native names (which are mostly significant),

unless they be too harsh and difficult of pronunciation, or to give them names founded on some local and *constant feature.* Every mountain or chain named or mentioned, must be as exactly as possible defined as to limit and extent.

Arrangement and Direction.—If the mountains or hills of the country form a single chain, what is its direction, length, and breadth? If they compose different chains, what is the direction, length, and breadth of the principal chain, the direction, and relative disposition of the subordinate chains? Are they nearly proximate, or are they connected? if the latter, in what point or points, and how? Should the mountains be disposed in one or more groups, the situation of these must be indicated. In large groups the better way is to describe their situation and extent, by stating that they reach from such and such defined points, in such and such direction, to other defined points, the distance being so much. In smaller groups, the centre or the highest mountain, stating which, being taken to mark the position of the group, the extent of the latter in different dimensions round the former, must be given. Isolated mountains must have their position and bearings well determined.

Height.—The height of mountains is an important object in physical geography, and should, therefore, be always ascertained by the traveller, correctly if possible, if not, approximately; *taking care,* however, *never to give approximation for positive data.* The various methods of taking heights will be found in the section entitled OPERATIONS. We may observe, that not only the height above the level of the sea should be given, but also the height above the plains on either side; for the acclivities being, as we have said, set upon inclined plains, the vertical height of a mountain above its base, is often, nay always, different, as measured from the plains on the opposite side. The great difficulty is in discovering where the rise of the mountain or ridge really begins, as the plains themselves are sometimes the insensible prolongations of the mountain slope. In these cases, it is usual to reckon the height from some town or remarkable place, considered as being situated in the plain. In the cases of chains, the mean height of the ridge must be given, and the particular height of the higher peaks, and of the passes and defiles.

Form.—Whether mountains be in chains, groups, or isolated, their general and particular form should be noted. And here it may be remarked, that mountains seen at a

distance present a very different aspect from their appearance when near. The minor inequalities are smoothed down by distance; and very rugged rocks, when seen afar off, frequently present an easy and rounded outline. A group in the distance appears as a continuous chain.

The general forms of mountains are as follows:—the *Pinnacled* or *Needled*, the rocks being bristled up into sharp tapering masses; the *Table-shaped*, presenting a nearly straight outline, which is the edge of a plain or tabular summit; the straight outline, however, is not always a sure indication of a table-shaped summit, it may sometimes be the horizontal ridge, formed by the meeting of opposite slopes, or the termination of an acclivity in a bluff or cliff. Table-shaped mountains have frequently one or more abrupt and nearly perpendicular sides for a certain way down, succeeded by a slope, formed by the accumulated débris. The *Saddle-back* shape is that on which the two extremities of the mountain are higher than the intervening space, which presents a concave outline. The *Hog's-back* is the reverse of the saddle-back. The *Dome* shape is the type of the *Rounded*. The *Lumpy*, as its name implies, presents a confused mass of more or less rounded summits. The *Ruiniform* presents, at a certain distance, so perfect a resemblance to ruined walls and towers, that nothing but close inspection can undeceive. This is frequently the case with limestone and sandstone rocks. The *Conical* or *Sugar-loaf* shape is that which is almost peculiar to volcanoes, though sometimes assumed by quartz-rocks. Volcanic cones are rarely perfect, in consequence of the crater. All other forms are modifications and combinations of the above. The trap-rocks, however, sometimes exhibit the singular appearance of rising like steps, whence their name: this form might be termed the *Graded*. Certain mountains, as seen in particular positions, bear a rude resemblance to animals and other objects; and are sometimes named in consequence. A practised eye will, in many cases, enable the traveller, from the appearance of mountains, though even at a distance, to guess correctly at the sort of rock of which they are composed. Though *nothing guessed at must be given as certain.*

Slope.—With regard to the slope of mountains, we would caution the traveller against judging of the positive precipitancy of slopes by the difficulty of ascending them. The maximum for carriages is a slope of seven or eight degrees;

the maximum for beasts of burden, and which would be considered very steep, is only a slope of fifteen or sixteen degrees; and a mountain so steep as to be climbed only by cutting steps, is still but 35°; while an ascent of 44° cannot be climbed even by cutting steps.

As for the general slope of chains, that is, the inclination of a line passing from the summit to the plain, it varies from 2° to 6°. The northern slope of the Pyrenees, according to d'Aubuisson, is from 3° to 4°, and the southern slope of the great Alps, from the general summit line to the plains of Piedmont and Lombardy 3¾°.

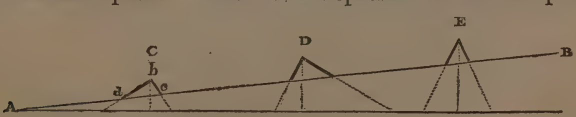
The opposite slopes of a chain of mountains are seldom of equal inclination, and the traveller will do well to pay attention to this circumstance. Some have thought that, generally, in chains running North and South, the western slope was the steepest, and that, when the direction was East and West, the southern slope was the more abrupt. This, however, is very far from being always the case. General Andreossy says, that when a chain of mountains is situated on an inclined plane, (*plan de pente*,) the abrupt side is that which is opposed to the inclination of the plane, and such is really the fact in many instances. This, however, seems only to refer to such chains as run in a direction perpendicular to that of the dip of the inclined plane. Now, as we regard the whole surface of the earth as composed of various inclined planes, and as the mountain chains are set upon these in every possible way,* it will be interesting to observe if any, and what, relation exists between the abrupt sides of the chains and the direction of the chains as regards their position on the facet or inclined plane. Thus the Pyrenees and the parallel chains which lie between the Douro, the Tagus, the Guadiana, the Guadalquiver, and the Mediterranean, run in a direction corresponding to that of the dip of the inclined plain which forms that portion of the country, which dip is from East to West; whereas the principal watershed (the *divortia aquarum*) which sepa-

* The importance of observing the relation which exists between the direction of mountain chains and the plains is evident, when we consider that geologists regard the plains as upheaved from under the sea; the mountains being the great centre of disturbance, and the plains, therefore, dependant on the direction and extent of the rise. Now, as this absolute relation by no means exists everywhere, it follows, that, in some cases at least, the plains and dry land were upheaved before the mountains which cross or bound them.

rates the rivers just mentioned from those which flow westward into the Mediterranean, runs in a direction, not only perpendicular to the dip of the western plain, but is set upon the exact intersection of two opposite plains, about the meridian of 1° West. Now, as these plains terminate at the sea level, or same horizontal line, and as the length of the eastern plain is not half the length of the western, it follows of course, that if these plains are to be regarded as the prolongation of the slopes of the chain, the eastern slope will be more abrupt than the western. But these plains cannot with propriety be regarded as parts of the chain, the bases of which terminate in the plains East and West, long before we arrive at the coast on either side; and this being the case, there seems no reason why the steepness on either side may not be the same, that is, a mountain chain may be set on the intersection of two opposite and differently inclined plains of the earth's surface, and yet have its opposite slopes equally inclined to the horizon. The following diagram will render this evident.

Let A C represent the horizon; A B and C B the vertical section of two planes meeting in B; let *a b c* represent the vertical transverse section of a mountainous range set on the intersection of the two planes. Now the two opposite slopes, *b a* and *b c* of the chain, may make the same angle with the horizon A C, as seen by their continuation downwards to that line, or they may make different angles, as if their direction were *b d* and *b c*, in which the steeper slope is opposed to that of the long plane, or *b e* and *b a*, in which case they would be the very reverse of what General Andreossy regards as generally the fact.

The same variety may exist if the chain, instead of being set upon the intersection of two planes, be set on any part of a plane in a direction perpendicular to the general slope of that same plane. Thus if A B represent an inclined plane,



a chain C, may be set on it, having the counter-slope *b c*

steeper than the slope *b a;* or the chain may be as at D, in which the counter-slope is the least rapid; or, finally, it may be as at E, with both slopes equally inclined. If the traveller should meet with the cases D and E of the figure, it is evident the observation of General Andreossy is not universally applicable.

If we have dwelt so long upon the subject it is because it is one which has been thought worthy the attention of philosophers, and it is therefore desirable to ascertain if any general law maintains or not regarding the slopes of mountain chains; and, if there be such a law, to determine it with precision.

Whenever the inclined plains or general slopes of a country form part of the mountain chains, as is the case in long narrow islands, of course the shortest slope will be steepest; or if the chain be strictly central, the opposite slopes will be equally inclined to the horizon.

PLAINS.—We have already observed that by the word Plain we are not to understand a perfectly horizontal surface. Plains are tracts of greater or less extent on which there are no mountains, but which may, nevertheless, contain inequalities of a certain height without ceasing to be plains. Thus they may be divided into undulated and level plains, the former differing in degree, as being very undulated or but slightly so, and the latter being more or less inclined, and, sometimes, nearly horizontal.

As there are no plains, with the exception of vast sandy deserts, which have not their watercourses,* it follows of necessity that there must be inequalities in the level of their surface, however horizontal this may seem in the general view; and hence there are the *Valleys of the plains* as well as the *Valleys of the mountains.* When the former of these are broad they are seldom deep, or, which is the same thing, the watershed is but a gentle acclivity whose ridge-line is hardly to be traced; they are, sometimes, on the contrary, narrow and more defined, in which case the watershed is also generally more prominent, and occasionally rises into distinct continuous ridges or chains of hills of a certain elevation. It sometimes happens that the rivers do not flow along the bottom of a hollow or valley, but seem, as it

* We hold that these also have their rivers flowing through them, but they are hidden from the view. The drifted sand fills up their beds and obliterates them, but the water steals along beneath, and is sometimes found by digging to be at no great depth below the surface.

were, to have excavated natural ditches for themselves in an apparently horizontal surface. In some of these nearly level valleys, and this depends upon the nature of the soil, the rivers wind and bend very much; in others, their course is almost straight, and, occasionally, they split into a number of anastamosing branches, enclosing islands of greater or less extent.

Some plains, after a gentle rise from the coast, continue almost horizontal to the immediate base of the mountain; some rise by successive steps, each horizontal, and others, again, present a continued surface considerably inclined.

Plains offer great diversity of aspect according to the nature of their soil and the abundance of their waters. If the soil be good and water abundant, they will be fertile; and if fertile, will be inhabited permanently or periodically, according to the population of the country and the progress of the people in civilization.

The above enumeration of the various characters which plains present, will suffice to point out the nature of the observations to be made by the traveller regarding them. We may, however, remark, that it is particularly desirable he should note the slope of the plains, both as to direction and quantity; the direction of that part of the main trunk of the river that flows along them; the position of this water-course as running along the edge of the plain, and, in this case, which edge, or as running across the plain; together with the direction of the hilly ranges that traverse, or the mountains which border the plains, and the steepest sides of these hills and mountains, in order to ascertain if any constant relation exists between these several objects.

SECTION II.

HYDROGRAPHY, OR THE WATERS OF A COUNTRY.

SPRINGS.—It frequently happens that springs break out unobserved, as when they open into the beds of rivers, lakes, marshes, &c. When they are seen, the follwoing particulars should be carefully noted:—

The precise situation of the spring, or its bearing and distance from known points, and height above the level of the sea.

Is it in the bottom of a valley, on the slope of a hill, or, as is sometimes the case, on the top of the highest visible ground?

Does the water issue from the fissures of a rock, from between beds or rocks of different natures, or from a cavern?

In those mountain ranges where glaciers are accumulated, the gradual, though constant, thawing of these at their lower surfaces gives rise to a kind of springs which issue, more or less abundantly, from picturesque grottoes of ice.

Does the water of the spring ooze imperceptibly, as frequently happens through sand in valleys, or through the sides of slopes; does it fall in drops, or gush out with greater or less violence in a stream, or does it form a *jet-d'eau*, and, if so, what is the height and thickness of the column of water?

Is the flow of water constant or intermittent; if intermittent, is it regularly or irregularly so? Is the intermittence one of flow and no flow, or merely regular or irregular returns of greater and less abundance of water? In every case, the time and duration of the different phases of the phenomenon should be noted, and its cause. The temperature of the water must be accurately observed at different hours of the day, and in different seasons, taking care to note, at the same time, the temperature of the external air, or of the cave or grotto, as also of the soil. It is particularly recommended to the traveller to take the temperature of all the springs he meets, and to note as many of the circumstances connected with them as he can. The temperature of wells should also be taken. What is the quality of the water; is it clear or turbid? It may be acidulated, saline, hepatic, or ferruginous; it may be remarkable for its colour, taste, or smell; it may be incrustating, that is, it may, upon coming in contact with the air, let fall the silicious or calcareous matter it before held in solution. In such case, note must be made of the kind and manner of the deposit, and the rapidity of the process, the quantity of matter already deposited, its appearance, properties, and the uses to which it is or may be applied.

Does the spring cast up any remarkable substances; does it emit any inflammable or noxious gases?

What is the quantity of water furnished by the spring in a given time?

What is the nature of the rock or soil, and the dip and direction of the strata: the kind and abundance of the her-

baceous, aqueous, and cryptogamous plants which grow around the spring?

For the analysis of mineral waters see APPENDIX.

RIVULETS.—Nothing can well be more vague than the line which separates what is called a Rivulet or Brook from a small River; indeed, the terms are frequently used synonymously. Rivulets, however, for want of a more precise definition, may be distinguished from rivers by their being neither floatable nor navigable. They proceed immediately from springs, and, when they receive other waters, it is only those of small streamlets like themselves, which add but little to their own mass and velocity.

Rivulets are frequently turned to useful account by the retention of their water to form mill-ponds, or for the supply of canals, for irrigation, &c. Rivulets are often dried up in the hot season; at other times their waters are generally very limpid, whether flowing through a boggy soil or over a pebbly bottom, and where constant, have, sometimes, abundance of fish, particularly trout.

Of course, whenever the spring from which a rivulet immediately proceeds is intermittent, the rivulet will be so likewise.

These few remarks will suffice to point out the nature of the observations which it may be necessary to make on rivulets, independent of, or in conjunction with, what may have been observed of the springs which immediately supply them.

TORRENTS.—Torrents have generally very deep and rugged beds; they flow at the bottom of gullies and ravines which they have sometimes themselves formed, and which they are ever deepening and widening.

Torrents, by reason of their rapidity, generally carry down a quantity of débris, and are, therefore, turbid. They, however, let fall the impurities they hold in suspension whenever their course is impeded and their velocity retarded. Thus bars, shoals, and, eventually, islands, are formed near the spot where a torrent enters a river or lake. The magnitude, form, and exact position of these deposits depend upon the nature and quantity of débris brought down by the torrent, the angle under which the torrent enters its recipient, and, when this recipient is a river, on the mass and velocity of the confluent streams. These deposits sometimes change the bed of the recipient, at first and most sensibly, in the parts adjacent, and subsequently, for a long way down.

Torrents sometimes form lakes and pools by the accumulation of their deposits obstructing further egress.

Torrents are occasioned either by the rapid thawing of snow in the mountains, or by very heavy or periodical rains. At what time of the year does this melting of the snow take place, or do these rains fall? What winds bring the latter; how long, generally, do the rains continue to fall, or does the snow continue thawing?

Torrents occasionally cause the most dreadful ravages, and, consequently, in well-peopled and civilized countries, various means have been devised and practised with greater or less success to secure the country from their devastations; it is, therefore, of the greatest importance to examine the several methods adopted, the principles on which these methods are founded, and the degree of success which attends them.

The imprudent denudating of the hills has frequently created torrents where none before existed, and the covering the heights with trees has sometimes greatly contributed to diminish the velocity of torrents. It is also very necessary to examine the nature of the dĕbris brought down by the torrents, particularly in exploring a new country, as these often lead to the most important discovery of mineral treasures.

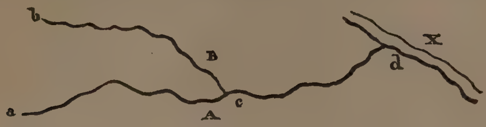
RIVERS.—*Name.*—Is the name the same from the source to the mouth of the river or different in different parts? Have the several sources, the anastamosing and *deltic* branches, when such exist, the same or different names? Specify the points at which the names change, the extent, direction, and nature of each separately named part, in all the detail indicated below, proceeding from the source towards the mouth, or *vice versa*, stating in which order.

What names has the river formerly borne? When, why, and by whom changed? Does it still bear different names, and if so, what are these names, and by whom are they respectively used?

Have the present or former names any relation to the quality or nature of the river, the vegetation on its banks, or other natural circumstance, or to any traditions, superstitions, or historical facts? If so, state the precise signification of the name.

It sometimes happens that the part of a river immediately below its junction with some other river, is dif-

ferently named by the inhabitants on the opposite banks,



thus, the inhabitants at A, accustomed to regard *a d* as *the* river, give the same name to the part *c d* as to the part *a c*, and say that *b c* falls into *a d*. The inhabitants of B, on the contrary, consider *b d* as *the* river, of which they look upon *a c* as an affluent. Now, should these waters at the point *d* disembogue into some other river, which we shall call *x*, it would be said by different travellers, according as they had their information from the side A, or the side B, that the *b c* river falls into the *a d*, or that it falls into the *x*.

On the spot this may be of little consequence, but in travellers' accounts of countries little known, this circumstance should always be enquired into to avoid error. The above is exemplified in the case of the rivers Bug and Narew in Poland.

Origin.—Does the river derive its origin from one or several sources or springs, or from a lake or a marsh? What is its height above the level of its mouth? See SPRINGS, LAKES, MARSHES.

Course.—Is the general course straight (*a*), serpentine, (*b*), meandering (*c*), or winding (*d*), or any compounds of these, *in toto* or in part.*

Thus the Vermejo and the Magdalena may be called

* The figures are supposed to represent, not any *portions* of rivers, but their *whole course* from origin to recipient.

straight-serpentine, the Nile *meandro-serpentine*, the Orinoco *winding*, &c.

As it may perhaps be objected by some, that the forms of rivers are not sufficiently precise to admit of this classification, I will observe that they are more precise and determined than the forms of clouds, which have, nevertheless, been classed and named, and the classification generally adopted.

What is the general direction, (true or magnetic being stated), in one line or in several, according as the river winds more or less, omitting always the minor curves and sinuosities ?

The length of the several lines individually and *in toto*, and the length in following the bends, stating always whether these lengths are presumed, asserted, or actually estimated, and, in the latter case, by what means.

Very extraordinary bends in meandering rivers, as those in some parts of the Missouri, should be particularly noticed, stating the circuit the bend takes and the direct distance across the isthmus.

Does the river in its course run through the middle of the valley, or does it cling in preference to the base of the heights on either side, and, if so, which side, or does it change sides in different places ? Does the river run through a longitudinal valley, or does it cross one or more longitudinal valleys and their dividing ridges, and, if so, under what angle, and what are the appearances where the ridges are intersected by the stream ? Is there at this point an anticlinal dip on both sides, or not ; are the strata horizontal, or vertical, or synclinal ; what is the nature of the rocks, are they the same on both sides or different ; are the surfaces smooth and water-worn, or fragmented and confusedly heaped as if by sudden falling in of a cavern, or by explosion from below, or forcible rending ?

Recipient.—Is the recipient some other river, or a marsh, or a lake, or the sea? In either case, what is its name and the place of junction, which latter may be either approximately or absolutely determined in different ways, as, astronomically, or by actual admeasurement from some known point, as a town, a fortress, a castle, a ruin, a remarkable rock, either on the river itself or on its recipient, or by distance and bearing from some striking or well known object away from either.

Mouth.—If the river empty itself into a recipient by

two or more mouths, it forms a *Delta* (which see); if by one mouth only, observe its width, and depth, and the angle formed by the affluent and recipient. Has the mouth of the river undergone, or is it still undergoing, any notable change; and of what kind. Have the former changes been sudden or gradual, and are they rendered evident by, or are they merely presumable from, the nature and present configuration of the soil about the river's mouth, or is there any historical or traditionary evidence of such change?

Is the apparent breadth, mass of water and rapidity such as might be expected from the length of course and general size of the river, or is it greater or less? In either of these latter cases, state the ascertained or probable reason of such anomaly. In the first case it may be owing to a subterranean affluent or springs, in the latter, the diminution may be occasioned by a subterranean drain or by infiltration through the soil, or extraordinary evaporation.

Does the river form a bar, or shoal, or islands at its mouth, if so, what is the extent, direction, and nature of such deposits; how far do they obstruct or endanger navigation; or, in the case of the river emptying itself into the sea or a large lake, how far do these objects contribute to the security of anchorage within them? Are the shoals at all times covered, and with what depth of water at different seasons, or tides, if such exist; or, if periodically uncovered, at what times of the year? Are the deposits permanent as to place, or are they liable to shift? Are all or any of these undergoing increase of size, or diminution?

When rivers on approaching the coast, as is frequently the case, turn suddenly round so as to follow a course parallel to the sea before emptying finally into it, observe the direction of this bend in reference to the prevailing winds and currents of the sea or the ocean at that spot.

A Delta.—Deltas are *Fluviatile* when formed at the entrance of one river into another; *Lacustrine*, when at the embouchure of a river into a lake; and *Maritime*, when the river falls into the sea. The original cause of a Delta is sometimes a natural obstacle, which splits the stream into two branches, but it more commonly results from a bank deposited by the river itself: Thus the soil of deltas, generally, is alluvial and, as such, fertile, unless the river brings down nothing but pure sand. The alluvial soil is sometimes confined within the two external or deltic branches of the river, but more frequently it extends beyond these.

Within the *deltic* branches there are frequently many other diverging and anastamosing branches, which for distinction's sake may be called *Ana-deltic*, and which cut up the delta into a greater or less number of deltic islands.*

Besides such observations as may be dictated by the foregoing remarks, it is necessary to notice the direction and length of each of the deltic branches from the point of divergence, and the angle they make, together with the distance from the mouth of the one to that of the other, or the base of the delta; the number of channels exclusive of the two outer ones; the number and particular names, together with the breadth and depth, of those that are navigable, and the preference that is, or should be, given to any of these, and why? What is the superficial extent of the space contained within the deltic branches, and the nature of the soil, as sandy, swampy, or fertile; and if the latter, what is the nature of the vegetation? If subject to inundation, at what time of the year and for how long; to what height does the water generally cover the land, and what thickness of deposit is annually accumulated? Are any of the channels subject to change, and, should the delta increase in size, to what extent, and in what direction?

Confluence of two rivers.—Is the recipient stream increased in width, in depth, or in velocity only, after receiving the waters of the affluent, or in any two, or all three, of these ways? stating the increase of width, depth, or velocity. It frequently happens that the waters of the two meeting streams are of different colour, or that the one is clear and the other turbid. In either of these cases it may be noticed how far below the point of junction the waters flow without commingling. Does the velocity of either river in times of flood impede the progress of the other so as to cause in either a rising of the waters, a back-current, or an inundation? Does this happen annually, and what is the extent of the phenomenon, and its effects?

Affluents.—The affluents of a river must be mentioned in their proper order, whether proceeding from the mouth upward, or from the head or source of the river downward, stating which, and whether the affluents are on the right or left hand. As for the effects produced by them on the river under consideration, all that is necessary to observe on this

* These terms *Deltic* and *Ana-deltic*, have been approved by a Committee of the Royal Geographical Society, appointed for the purpose of endeavouring to form a precise geographical terminology.

subject is contained in the three preceding articles, in which the river under examination was supposed the affluent, and its effects on its recipient considered; whereas now the river is to be regarded as a recipient and considered with reference to the modification effected by its affluents.

Bed of a river.—By the bed of a river we understand the channel which the river has chosen or which it has excavated for itself.

It rarely, perhaps never, happens that the bed of a river is at the present day such as it was formerly, on the contrary, we see changes going on continually. The changes rarely affect the general direction of the river, which from the beginning, being along the general line of greatest slope, cannot well vary; they are therefore confined to the embouchures and minor curves of the rivers.

The variation in the bed depends upon the direction and the strength of the current and the nature of the soil, which circumstances reciprocally modify each other.

The impinging of the current against a re-entering angle of the bank, wears it away at that part, more or less, according to the tenacity of the soil, and the débris, urged on by the stream, form shoals and promontories lower down, which, in their turn, divert the direction of the current. The wider the bed, *cæt. par.*, the slower the current, and the narrower the bed the greater the rapidity of the stream, and the greater its tendency to deepen the channel; the banks, however, are little affected when the course is straight. The slope of the bed, also, modifies the velocity of the current; but in order to produce any remarkable change, great rapidity must be combined with a great mass of water and a loose soil.

These remarks are sufficient to suggest the nature of the observations to be made on the bed of a river; we may, however, add, that the following objects should also be noticed, viz. the parts of the channel where there are whirlpools, shoals, islands, cataracts, or other natural accidents, as also embankments, terraces, weirs, or other artificial works.

The breadth, depth, and slope of the bed must on no account be omitted. (See Section entitled OPERATIONS.)

Soil of the bed.—The soil may be

Sand { 1 Fine.
2 Coarse.

Gravel { 3 The size of a grain of annis.
4 The size of a pea.
5 The size of a bean.

Stones { 6 The size of an inch in diameter.
7 The size of an egg.

Large stones.
Huge blocks.
Solid rock.
Ooze, *i. e.* mud or slime.
Clay.

The utility of this classification will be seen in the following article.

Velocity of a River.—The velocity with which a river flows may be great, middling, or little; regular, or irregular, both as to time and place. This velocity should be indicated by the number of nautical miles in an hour, or feet in a second. The velocity of the surface is different from that of the mass. For the method of obtaining both, see OPERATIONS.

The first seven kinds of soil mentioned in the preceding article, are respectively disturbed by the following velocities, viz.:—

No. 1	by a velocity of	6 inches per second.
2		8 inches
3		4 inches
4		7 inches
5		12 inches
6		24 inches
7		36 inches

The disturbance here mentioned, is the stirring and transporting power of the water, independent of shock; thus when the impinging of a stream against its banks has detached any part of them, such part will either fall at once to the bottom, or will be carried away, according as the nature of the soil, and the rapidity of the stream, be such as above indicated.

Thus, by a knowledge of the nature of the soil, the tendency to erosion of the banks, by the impinging force of the stream (different according to the angle under which it strikes), and the velocity of the current, a tolerably correct idea may be formed of the stability of a river's bed, or its tendency to change.

The changes in the bed of a river are not confined to its direction; the filling up and clearing of the bed is also subject, particularly in certain rivers, to great change. Thus, the first effect of floods, is to clear and deepen the bed of a river; whereas, the subsequent effect is to fill it up

again; because, as the torrents slacken, they deposit the débris they have no longer the force to keep in suspension: and thus a river may have its bed deeper or more shallow after a flood than before, according to circumstances.

Banks—This word, like almost every other name in physical geography, is vague and indefinite. Thus, a Bank is either the lateral margin of a river, that is, that part of the land which, with regard to a river, corresponds to the shore, as regards the sea, or it signifies an accumulation of sand or gravel, in a word, a shoal. If the latter, for distinction's sake, were called a sand-bank, we should of course know that a shoal was meant; but this term would often be incorrect, inasmuch, as shoals are sometimes gravel-banks and mud-banks, as well as sand-banks. This shows how desirable it is to have a definite terminology. But, until such can be established, we can only recommend to travellers to avoid, as much as possible, all equivocal expressions. In the present case, the only way by which ambiguity may be avoided is, when the word bank is used to denote a shoal, to speak of the banks *in* a river; and, when the margin is meant, to say the banks *of* a river. We ourselves confine the term *Bank* to the margin of a stream; using, in other cases, the term *Shoal* exclusively; and we recommend this to others. Of Banks, then, the traveller should observe:—The nature of the banks of the river; the ravines and gullies by which they are intersected.

Are the banks abrupt, or shelving, or gently sloping; are they, in this respect, the same on both sides generally; or is the one bank much higher than the other, and which? Are the banks swampy, sandy, rocky, of clay, or of vegetable mould? Are they sterile or covered with vegetation? If the latter, is it spontaneous or cultivated; and what are the plants, crops or plantations, seeds, grass, brushwood, forests, &c.? In the neighbourhood of towns, we may find upon the banks, vegetable gardens, nurseries, parks, promenades, &c.

When streams meander much, it is observable, that in the bends, the bank is always steepest at the re-entering angles, and most shallow at the salient angles, and that the water is deepest under the steeper bank; whereas, when the two banks are equally steep, the deepest part of the river is in the centre. This equality of the banks is usually found in those parts of the river where its course is straight. The wearing away of the banks takes place at the steep parts, which, unless the soil be sufficiently tenacious to resist the

eroding* action of the water, are constantly falling in; whereas, at the salient angles where the water is shallow,

* Erosion, corrosion, abrasion, exfoliation, disintegration, weather-wearing, are terms very frequently misapplied; and as it is of considerable importance not to attribute effects to a wrong cause, the following distinctions should be attended to by all exact narrators of the physical operations of nature.

Erosion is the gradual wearing away of a body, commencing at the surface (without any reference to horizontality), and effected by the mechanical agency of moving water, in two ways, either singly or combined; first, by penetration and loosening of its component parts; and secondly, by forcible separation and bearing away of particles.

Corrosion implies, not mechanical, but chemical agency, such as is observed in the case of rocks acted upon by the various gases, arising from volcanoes, and from the cracks and chasms in their vicinity, the vapours of certain springs, and mineral waters themselves. Corrosion seldom acts equally on all the component parts of rocks; it attacks some and leaves others untouched; and of the parts attacked, it sometimes happens that their nature is changed without apparent diminution of substance; and sometimes the parts which have undergone chemical change, are thereby rendered soluble, and are then carried away by rain and atmospheric motion; in which case, the corroded mass presents a carious or honey-combed surface. Erosion carries away all the parts by degrees, and what is left of the mass, is in an unaltered state; whereas, corrosion sometimes goes only to a certain length, and what it leaves, is always in an altered state.

Abrasion is the wearing away of the parts of a rock or of the soil from the banks or bottom of water-courses by the impinging and friction of some solid body; thus the rocks which form the sides and bed of a torrent are frequently abraded, and sometimes worn into regular furrows by the friction of the stones carried down by the stream. Floating ice, or sliding glaciers and timber, also powerfully abrade.

Exfoliation is the separation into flakes or laminæ of those rocks or clays whose structure is fissile or laminary. This phenomenon results from the combined effects of moisture and extreme cold. The water penetrates between the laminæ of the stone where it remains till, being seized by frost, it becomes ice, which, by its known expansion, separates the mass into flakes. Great tabular masses are in this way detached from highly inclined stratified rocks.

Disintegration is the separation of the component ingredients of a compound cristaline or conglomerate rock, resulting sometimes from the same cause as that which produces exfoliation, and sometimes from a particular chemical agency of the atmosphere but little understood, as is the case with the Ingrian granite, and with some other similar rocks observed among the erratic blocks of the Alps.

Weather-wearing is a term used only adjectively, and is of vague signification. By a *weather-worn* rock, we mean one which exhibits evident marks of alteration, produced by the chemical and mechanical agency of the atmosphere.

By *water-worn* is meant the result of the action of water in motion; it is, in fact, the result of *erosion*, but is frequently confounded with the effect of *abrasion*.

the land gains upon the water. These observations are of great importance for ascertaining the situation of fords; for determining the best place for the construction of bridges; and the erection of buildings on the edge of the river. We may here observe, that whenever a river is reconnoitred, with reference to military movements, and these must never be lost sight of in the choice of a river as a boundary line or frontier, attention should be paid not to the relative height of the immediate banks only, but also to that of the land on both sides of the stream, to the ordinary distance of cannon shot, particularly in the neighbourhood of those places where the stream is, or may be, crossed. But for other particulars connected with the military view, we refer to a subsequent chapter. See THE COUNTRY CONSIDERED UNDER A MILITARY POINT OF VIEW.

Wherever spontaneous vegetation, not aquatic, is seen on the borders of a river, it were well not only to describe it, but also to observe whether it be the same as, or different from, that which is seen at a small distance from the river; for should it be different, it may be inferred that the seeds of such plants may have been brought down by the stream, and deposited here, where, finding a suitable soil, they have germinated, and the plants been in this manner propagated. Thus useful information may sometimes be obtained, and even important discoveries made, regarding the vegetation of the higher parts of the river. In every case, the nature of the spontaneous vegetation on the banks of the river must not only be noted, but the uses to which that vegetation is, or may be, applied. It were also well to remark, whether the vegetation, be it spontaneous or cultivated, which is met with on the banks of a river, differ from vegetation *of the same kind* found further removed from the water; and, if so, in what the difference consists, and how far it may be attributed to the damp atmosphere, and other circumstances connected with the immediate vicinity of the river. In the case of cultivated banks, observe whether advantage be taken of the river for the purpose of irrigation; and, if so, what is the method employed. For the effect produced in rivers, by the débris brought in by torrents, see TORRENTS.

Erosion of the Banks of a River.—If the traveller sojourn for any length of time in the immediate vicinity of a river with crumbling banks, he will do well to ascertain the superficial extent of land carried away in a given time, and, if

possible, the cubical quantity of soil removed to a distance, which will, of course, depend on the nature of the soil; for should it be gravel, the stones, from their size, and the small rapidity of the stream may be merely precipitated to the bottom of the bank, while the sand or clay is carried off; an inspection of the soil will determine this with sufficient accuracy.

Quantity of water discharged by the river at a determined point in a given time:—

This problem, highly interesting to physical geography, can hardly be determined by the casual traveller. Those, however, who remain a sufficiently long time at a convenient place, and are desirous of ascertaining the discharge of a river, will find the method of proceeding detailed in section OPERATIONS.

*Débris** brought down by a river. As it is essential to the elucidation of certain geological theories to ascertain, as exactly as possible, the changes now going on at the surface of the earth, and as one of the chief agents in these changes is the transportation of Débris by rivers, it is essential to examine the quantity and the nature of the solid matter held in suspension in running water. *See* OPERATIONS.

The larger Débris, unless during the temporary impetuosity of torrents, immediately subside, so that their quantity is difficult to ascertain. It will nevertheless be right, whenever there is an opportunity, to note the quantity and kind of such large Débris accumulated at any particular spot in a given time. Great attention must also be paid to the kind and quantity of organic remains, whether animal or vegetable, seen floating down rivers or deposited in particular places, noting the place and distance whence they come, the manner of the deposit, and the nature of the soil in which these remains are placed.

Islands.—The islands that are met with in rivers are of three kinds. Wherever there is a bifurcation of the river, and the branches thus formed re-unite, the land they enclose is an island which, for distinction's sake, may be called a

* By *Débris* is meant generally the fragments of rocks, the boulders, gravel, sand, trunks of trees, carcases of animals, &c. detached from the summits and sides of mountains by the effects of the elements, or resulting from sudden convulsions at the surface of the earth, &c. By *Detritus* we understand the same débris finely comminuted or pulverized by attrition. Débris in general comprises detritus, but detritus excludes the idea of the larger débris.

Branch Island. The other two kinds of islands, being in the continued and direct channel of the river, may be collectively called *Channel Islands,* to distinguish them from the Branch Islands ; but they are themselves distinguishable into *Bed Islands,* and *Shoal Islands,* or *Dry Shoals:* by the former are meant such as are of the same nature exactly as the soil through which the river flows, or of a nature still more compact ; by the latter are meant such as are formed by the deposition of the débris brought down by the stream. This distinction of the islands of a river is very important. Are the islands numerous and closely-clustered, or the reverse ? Are they in progress of extension or diminution as to size and number, or is there little or no appearance of change in these particulars ? Are they sterile, or covered with a spontaneous vegetation, and of what kind ; or are they cultivated, and with what ? Are they inhabited by men, or do they serve as the retreat of any particular species of amphibious or other animals ?

Islands are sometimes of great utility : advantage may be taken of them in the construction of bridges, it being, in general, more convenient to construct two small bridges than one large one. They are also important when, being at the entrance of a river, they may be made to protect its approach.

Small islands in the immediate vicinity of towns, are often very advantageous for the establishment of powder-magazines, store-houses, &c. ; but in order to their being fit for such purposes, they must be sufficiently near, of easy access, and well sheltered from an enemy's fire.

In all cases where it may be proper to construct magazines or other edifices upon islands, or to fortify them, it is necessary to secure them against the eroding action of the stream and against inundations. In time of war, islands may be occupied for facilitating or preventing the passage of a river. When they are large, and well wooded, and have coves, they may serve to secrete or shelter a detachment, &c.

Thus in speaking of the islands of a river, every circumstance regarding them must be noticed. When new islands are formed in a river, are they the property of the inhabitants on the banks, or of the state ?

Particular Objects.—Besides the circumstances to which we have already drawn attention in the consideration of rivers, there are several others equally worthy of particular notice ; we shall mention a few.

Rapids are occasioned by a suddenly increased declivity of the bed of a river, the result of which is a corresponding increased velocity of the current. The rapidity is sometimes such as to endanger, or wholly to prevent, the navigation of the part of the stream so circumstanced. In Europe, rapids are not common, whereas, in some of the American rivers they abound; generally speaking, they are more abundant in primary and transition countries than in secondary regions, where, also, when there are any, they are more gentle: in alluvial districts they are very rare. They are almost always found in the passage of streams from the primitive to other formations. It is necessary regarding them to observe—

Their actual situation; the length of the fall itself, and its perpendicular height; the distance above and below the fall,* at which the increased rapidity of the stream becomes sensible; whether the current continues smooth, though rapid, or whether it be broken into eddies and whirls, and whether these are really dangerous, or only seem so; whether any advantage is, or might be easily taken of the fall as a means of moving machinery; whether the rapids are navigable or not all the year through, or at particular seasons, mention these, and for what species of boat; whether or not any particular precautions are necessary to be taken in ascending or descending the rapids, and what these precautions are; whether the nature of the banks permits of hauling the boats ashore and conveying them by land beyond the rapids. If circumstances render such an undertaking desirable, what are the most practical means of changing the bed of the river, or of diverting a branch of it so that the navigation may be rendered convenient and safe.

Cataracts and Cascades.—These two words are very vaguely employed; generally, however, the former implies a great mass of water precipitating itself in one or more unbroken sheets from top to bottom of a precipice, whereas by a cascade is meant a succession of falls, or the leaping of the water from rock to rock in its descent, as down a flight of steps. Cataracts and cascades, or, to use a more general term, falls, are very various in their aspect; sometimes it is a small fillet of water which, falling from a great height, is split into spray before it reaches the bottom; at others,

* *Fall* is a generic term, and is applied indifferently to Rapids, Cataracts, and Cascades.

the width of the fall is very great, whilst its height is insignificant. In some cases the water descends in a single unbroken sheet, in others it falls tumultuously over the projecting rocks with which the precipice is bristled, and consequently presents a mass of foaming water, bounding in an endless variety of forms among the dark rocks, which strive in vain to arrest its flight. Sometimes the water, perfectly limpid, presents the softened tint of the blue beryl, or the rich green of the emerald, and sometimes loaded with detritus, as sand or clay, it falls in a heavy, opaque, yellow mass to which immobility would seem more natural than motion. When to this diversity in the falls themselves there is added the various characters of the accessary objects, as the different tints and disposition of the rocky masses, the graceful, majestic, or gloomy aspect of the surrounding vegetation, it will be easily conceived that falls are very different in their appearance. It is for the talented traveller to describe these in a manner to convey to his readers a correct idea of the beauties or sublimities he may have witnessed. In a scientific point of view he will observe—the height and breadth of the fall, the way in which the water falls, and any particular phenomena by which the fall may be accompanied. It must also be remarked that, not only do falls vary from each other in their actual aspect, but that the same falls are liable to perpetual change in this respect: thus a cataract may at the present day have a very different character from what it had when described by former travellers. These differences must be carefully noticed, both as to kind and extent, and whether the change be owing to the constant action of the stream on a rock easily eroded or shattered, or to any difference in the quantity of water discharged at the fall, to the seasons at which the object was viewed, &c.

Cataracts and cascades intercept navigation altogether, unless in the case of light boats, which may be carried past them by land. In this respect, as also for the distance above or below the fall at which the increased velocity of the stream is sensible, the observations must be the same as those already indicated for *Rapids*. There is sometimes met with in rivers a kind of obstruction, half cataract, half rapid, or rather the two combined, as is the case in the Dnieper: it is occasioned by a sudden declivity in the bed, and by the rapid being crossed by a ledge of rock extending from side to side, or by a discontinuous ledge, or by inter-

spersed colossal blocks of stone. The Russians have three distinct terms for these three cases, whereas we have no specific name for either. When such obstructions exist they should be minutely described.

Eddies and Whirlpools are occasioned by the particular formation of the banks, or by the irregularities in the bed of the river, by counter-currents, obstructing rocks, shoals, &c. The water, for a certain distance, revolves on a centre, in a spiral direction. When the rivers are large, these whirlpools are often exceedingly dangerous to boats, which, when they once come within the vortex, can no longer extricate themselves, and are hurried on to their ruin. Whenever such eddies and whirlpools are met with, they should be specified as to the exact places where they exist, their cause, the distance at which they are felt, and the best means of annihilating or avoiding them.

Subterraneous course of a river.—It sometimes happens that rivers, in some part of their course, lose themselves for a while, and, after a subterraneous course more or less long, again rise to the surface. It hardly ever happens that the river is navigable in this subterraneous part, but, in some particular case, it might perhaps be made so; as when the stream passes through a mountain and comes out at the opposite side, at the same or nearly the same level. Whenever a river disappears the exact situation should be noted, and the manner of the disappearance, as whether it be by entering a mountain, by falling through a chasm or hole, or by filtering through sand, and the dimensions of the river where it disappears. Is the river entirely lost or does it again appear? and, if so, note the exact spot and manner of such re-appearance, as also the distance, in a straight line, between the points of disappearance and re-appearance. Is the quantity of water which comes again to the surface, equal to, or less, or greater than, the quantity which disappeared. Do objects thrown in at the point of disappearance appear again at the coming out of the river, and, if so, after how long a time? Does this time denote a very circuitous underground passage or very straight one? Some rivers, in the dry season, seem so completely to lose themselves as to leave the greater part of their beds dry, save a few pools here and there in the deeper parts of the bed; such rivers are frequently found to be flowing beneath the bed, when, by digging, water may generally be discovered. Circumstances of this kind must be noted, with the time of year during which

the river disappears, and the depth at which the water may be found, &c.

Shoals, permanent and moveable.—Shoals, as we have already observed, are formed of alluvium, gravel, sand, or mud. A knowledge of the quality of their soil, together with the strength and direction of the current, will pretty well enable us to determine if they are likely long to remain in their present state and position, and whether they will be increased or diminished. Those that are permanent should have their position noted, as also whether they are always, or only occasionally, submerged, and, if the latter, at what season. As for moveable shoals, it is almost needless to note their position, as this is perpetually shifting; this circumstance, however, should be mentioned, as also the part of the river to which they are more particularly limited.

Rocks.—Besides the rocky obstructions we have mentioned at the article Cataracts, there are frequently large blocks of stone in the bed of a river, which at certain seasons of the year only are impediments to navigation. These may frequently be removed, if the object be of sufficient importance. Regarding such rocks, it must be noticed, where they are situated, by what depth of water they are covered at different seasons, and whether they are protruding masses of a rocky bed, or merely detached erratic blocks.

Fords.—It is frequently of importance, even in civilized countries, where bridges and other modes of passage across rivers exist, to be able to pass them at other than these established places. This is most conveniently effected by fording or wading through the stream. Fords are not found in all rivers; some streams are never fordable, others always so; in some the fords are temporary as to season, though permanent as to place; and in others, they frequently change their situation. Rivers, or parts of rivers, whose banks are steep and course straight, are rarely fordable. Whenever fords, which, from circumstances we have reason to believe permanent, are discovered, they should be very carefully indicated, and direction given regarding the marks and objects by which they may readily be found. Should these fords, permanent as to place, be rendered impracticable by the increase of water at stated times of the year, this circumstance and the season must be mentioned. The fords of mountain-streams, or torrent-rivers, are generally rendered impassable whenever there is a fall of rain, but the impediment thus occasioned is not of long duration, and,

if the bed remain unchanged, the ford soon becomes again passable. Changeable fords need no other remark than their existence in the river at certain stated times of the year.

The inhabitants on the borders of a river generally know where the fordable passages are; but should it be necessary to seek them, they must be looked for in the widest part of the river, or in the diagonal line which joins the salient angle of one side with the salient angle of the opposite side.

To ford, on foot, the depth of water should not exceed three feet; on horse-back, four feet; but should the current be very strong, one foot less for each. Camels and elephants can, of course, wade through deeper water; care must, however, be taken in crossing rivers on elephants, for it sometimes happens, that so long as the elephant can walk on the bottom, with the extremity of his trunk above the surface, he will not swim; he must, therefore, be made to cross in a shallow or a very deep part.

The bottom at a ford should be firm and even; mud, weeds, or blocks of stone, are great obstacles, particularly in fording cattle. Sand is also very bad where a number of men or horses, and other animals, as in the case of troops, or a caravan, are to cross over; for the sand, being stirred up, is carried away by the stream, and the ford becomes impracticable for the hindermost. The opposite bank should also be accessible and clear, as it is of course useless to ford a river if further progress is arrested.

When fords are reconnoitred with purely military views, other considerations are necessary, but they will he treated of in another section. (See THE COUNTRY CONSIDERED UNDER A MILITARY POINT OF VIEW.)

Bays and Creeks.—The ground on the borders of a river is sometimes so broken as to form, in certain places, little bays or creeks. These, when of sufficient magnitude, should be noticed, together with their extent and depth.

Lagoons.—Fluvial lagoons are frequently found on the borders of rivers in particular situations. They may be formed either by the occasional or periodical overflowing of a river, or by the process of filtration, or by the accidental bursting of the banks. Thus when the land beyond the immediate banks of a river is lower than the banks themselves, this land becomes inundated by the overflowing of the river, and, unless, on the retiring of the water, they are drained, the water remains in the hollows forming lagoons of stagnant water, which are either dried up after a time

by evaporation, or which, though constantly diminishing, are not dried before a fresh inundation replenishes them. Thus, lagoons of this kind are temporary or permanent. The second kind of lagoon is that formed by filtration. When the soil of a river's banks or bed is such as admits the passage of the water through it, there is sometimes formed a lagoon in the low parts beyond the bank, and though the water of these lagoons evaporates, still, the supply being constant, the lagoon is so likewise; it will, however, diminish in extent according to the season.

For distinction's sake, the first kind of fluvial lagoons may be called *Flood Lagoons*, and the second kind *Filtration Lagoons*. The first, as we have said, being temporary or permanent, the second always permanent. Flood lagoons are generally in progress of diminution when the floods are of foul water, as is most frequently the case, for then this water deposits its detrital matter, and thus gradually fills up the hollows and raises the soil.

The kind of lagoons being mentioned, their situation and extent must be noticed, and, if temporary, where are they found and how long do they remain.

Both kinds are more or less detrimental to the health of those who live near them, in consequence of the putrid miasmata which they exhale. The facts on this point must be distinctly stated. Filtration lagoons are often covered with an aquatic vegetation, and sometimes harbour amphibious animals, or are periodically frequented by aquatic game in great quantity. All these circumstances are worthy of notice.

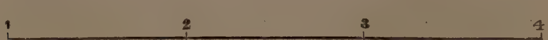
Inundations.—The overflowing of rivers, either when periodical or occasional, is an object of great importance, whether considered with reference to agriculture or to military purposes. The following remarks on the subject should, therefore, be made. If periodical, at what season of the year does the inundation begin, and how long does it last? and, whether periodical or occasional, what are the circumstances to which it is attributable? is it occasioned by the regular fall of rain, or melting of snow in the higher districts, or the accidental occurrence of violent rain brought on by certain winds? stating from what quarter they blow. What parts of the river are particularly subject to be overflowed, and to what distance in all directions does the inundation extend? Does the whole of the water subsequently drain off, or does the inundated part long remain in a swampy

state? Does the inundation cover the soil with sand and stones, producing sterility, or with a prolific mud? Is the inundation effected by a gradual overflowing of the banks or by their sudden rupture? Are any works established in order to keep the river within the banks or to regulate the inundation of the surrounding country?

We may also remark that, in some cases the inundations of rivers leave so little trace behind them that the traveller would never suspect their existence. Should he, however, observe the huts or houses on the borders of a river built exclusively on the eminences, or on terraces artificially raised, or on piles, he will not fail to remark that these are indications of periodical or frequent inundation, and will make his inquiries accordingly. An examination of rocks on the margin of the stream, or of the trunks of trees growing on its borders, &c., may prove the fact of inundations and the height to which the water rises. Are the inundations at the present day more or less extensive, or more or less disastrous in their effects than formerly? and, in either case, to what circumstances may the difference be attributed?

Tides.—The effect produced by the tides of the sea on the rivers which fall into it is different according to circumstances. In most cases a double effect is produced; first, the tide wave of the sea ascends the river to a certain distance, greater or less, as the tides themselves are greater or less, and the salt water penetrates into the river accordingly; secondly, the out-pouring water of the river, being impeded in its progress by the ascending tide wave, is forced back to a certain distance, and to this distance the tide is said to ascend though the water be fresh. In these cases it is necessary to note the distance at which the tide is felt in the river, under the different circumstances of mean, spring, and neap tides, and the distance to which the salt water of the sea penetrates, together with any remarkable anomalies occasioned by particular winds, currents, or form of coast-line.

It sometimes happens, as in the Hudson, that there is a double tide-wave, so that if the distance from the mouth of the river to the extreme point at which the tide is felt be divided by four points into three portions, as in the figure, it is high water at 1 and 3, while it is low water at 2 and 4, and high water at 2 and 4 when it is low water at 1 and 3.



Bore.—This is a phenomenon common to certain rivers, and which in different places receives different names. In the Dordogne, in France, it is called the *Mascaret.* In the Marañon it bears the name of the *Rollers;* but by the Indians it is called *Pororoca.* At the mouth of the united Tigris and Euphrates it is called *Bar*, and in the Hooghly *Bora*, or *Bore;* the name, perhaps, best known to our countrymen.

The Bore is a particular wave which rises to the height of from five to fifteen feet above the level surface of the river, sometimes singly, and sometimes followed by one or two more similar waves, and which rolls up the river to a greater or less distance, with a great noise and a foaming head, oversetting all it meets.

This phenomenon is not yet satisfactorily explained, but it is evidently connected with the state of the tides; it being only at spring tides that they are observed. Colonel Emy, who has written an interesting work on the motion of waves, attributes the bore to a ground swell.

When a river presents this phenomenon, every thing regarding it should be attentively examined, as the times when the bore occurs, that is to say, at what seasons, and what is the moon's age? What connexion is there between the bore and the tide? Is there one or more waves? Do they stretch all across the river, or go along one side in preference, or change sides, according to the windings of the river? To what height does the wave rise, and how far does it ascend the river? Particular notice must be taken of the state of the mouth of the river. What is its depth of water, and are there any rocks or shoals? for it is asserted that such obstacles as these latter, or great depth, secure a river from the inconvenience of the bore. Is wind found to have any effect on the bore, and what?

Freezing of the River.—Intensity of cold is seldom alone sufficient for the freezing of rapidly running water; a great deal depends on the continuance of the cold and the depth of the river; nor does the complete freezing over of a river always result solely from the direct effect of long-continued cold in the places so freezing. Thus, when rivers in cold countries have their sources in lakes, it generally happens that the lakes are the first to freeze along their edges. This border ice, if broken up by wind, is carried down the river, where some of the fragments, getting jammed, intercept the passage of the rest; the river thus becomes partially covered,

the surface water of the intervening spaces having its current impeded, quickly freezes, and the whole surface is soon one sheet of ice, which, in some rivers, would never be the case but for these floated ice floes. It is probable that no river can freeze over until the whole mass of water is cooled down to $42\frac{1}{2}°$ Fahrenheit. It will, therefore, be easily conceived that the congelation of a river greatly depends on its depth; for even the still water of mountain lakes in high and cold regions does not freeze if very deep. From these remarks it follows that the observations to be made are as follows:—

Does the river freeze only partially, that is, at its margins, or completely over? in the latter case, is it owing to the intensity of the cold directly, or to the previous fixing and collecting of ice floes? What is the depth and rapidity of the current? When does the freezing commence, and how long does the river remain frozen over? Is it, when in this state, passable for heavy carriages? To what depth does the ice generally attain?

From experiments made on the Neva at St. Petersburgh, it would seem that the thickness of the ice is proportionate to the increments of cold, so that when the precise additional thickness of ice for any given number of degrees,* (a thickness which probably varies with the rapidity of the current,) is ascertained, the total thickness of the ice may be pretty exactly known from the mean temperature since the first freezing over of the stream; or, what is more interesting, the time of first freezing being known, together with the proportion as above stated, the mean temperature, since that time, will be ascertained by the thickness of the ice.

Whether rivers freeze over or not, the ice floes which they bear along are often not only a serious interruption to the passage across, but in some cases they carry away bridges, and in others, altogether prevent the permanent establishment of any, except when a single arch or a suspension-bridge may be adopted. Any facts relating to this must be stated.

Be careful also to observe if the floating ice bears along any stones or erratic blocks; and if so, in what quantity,

* We cannot too often repeat that whenever degrees of heat and cold are stated, the thermometer used must always be mentioned. And we most strongly recommend the invariable use of the Centigrade thermometer in preference to any other; but indeed any is preferable to Fahrenheit's, which nothing but confirmed habit or inveterate prejudice induces us still to employ.

and of what size, as also to what distance they are carried, and whereabout they usually fall by the breaking, tossing, or thawing of the floes.

Subaqueous Ice, or bottom ice, improperly called *Ground Ice*,* or *Ground Gru*, is a particular congelation, which, in many rivers, perhaps in all, in cold climates, and in the winter season of milder ones, takes place at the bottom of the bed. The ice so found is rarely solid and compact, like that which forms at the surface of the water, but is a mass of small scales of ice without adherence, almost transparent when in the water, but white, like snow, when taken up. Opinions are various as to its formation, nor is it likely that the real cause of this singular phenomenon will be ascertained till more facts regarding it are accumulated. When this formation takes place in the shallow parts of clear streams, it may easily be seen, and though not so exposed in deep places, its existence is betrayed by the masses, which, getting detached from the bottom, rise by their specific lightness, and are seen floating down the stream. Regarding this subject, the following circumstances must be attended to.

When the bottom ice is seen, or being first indicated, is afterwards discovered, note in what precise parts of the river it is accumulated; is it at the sides or in the middle of the bed? in the deep or shallow parts, or indifferently in both? does it collect in preference about the rocks and stones, and if so, does it accumulate more particularly or exclusively on the sides opposed to the direction of the current, or the reverse? is it met with in the quiet parts of the river, or in those parts where the motion of the water is most tumultuous, or immediately below the rapid places? is it observed to form in sheltered and shady places, or only in such as are open, so as to leave room to think that radiation has any influence on the phenomenon? does it form on the beds of subaqueous vegetation? are the masses, groups, or patches of bottom-ice extensive? are large masses of it ever observed to rise to the surface, and, in so doing, do they ever bring up from the bottom attached sand, gravel, or huge stones? In what way are the masses observed to increase, and under what circumstances, with regard to temperature,

* The term *Ground Ice* should be exclusively used for that particular congelation which is found in the form of small crystals, or masses of greater size, embedded in frozen soil.

and cloudiness or clearness of the sky? Are the masses ever completely dissolved, and then followed by a fresh formation? Are they ever observed to form after the surface is covered with ice; or, having previously existed, do they disappear after the congelation of the surface? What is the general temperature of the water and rapidity of the stream? In a word, every circumstance must be minutely attended to in order to throw some light on so singular a phenomenon, and one hitherto so little understood.

Having thus specified the various objects of attention in a physico-geographical point of view, we shall consider a river with reference to its importance as a means of communication and conveyance; as a fertilizer of the earth; as a moveable power for machinery; as a reservoir of water for feeding canals; as a contributor to human subsistence by its fishes and water-fowl; and as a deposit of mineral productions.

Navigation.—If the river be navigated, is it so throughout the year, or at particular seasons, naming them? what are the settlements through, or near, which the river flows, and to what extent do these places profit by it as a means of communication and transport? Has the river, in any particular part of its course, not before navigable, been rendered so by works of art? if so, in what parts? what was the nature of the obstacles to navigation? how, when, and by whom have these difficulties been surmounted, and at what expense? At what part of the river's course does it begin to be floatable for large timber, and at what distance from the mouth does it cease to be navigable, severally for vessels of a certain tonnage, for barges, and for light boats?

Note the number of vessels, barges and boats, severally belonging to the different places—the detail of their dimensions and construction, their tonnage, and the number of hands necessary to navigate them.

The quantity, nature, and value of the merchandise transported from or to different parts. Are the productions so transported confined simply to objects produced and consumed by the border inhabitants of the river, or are they brought from a distance to be subsequently transported to places inland, or for exportation by sea? In the latter case, whence are they brought, and what is their ultimate destination? Is the navigation of the river as extensive as it might be? if not, to what is this want of activity owing? If it be in consequence of natural dangers or impediments,

such as whirlpools, rocks, banks, rapids, cataracts, &c., these must be specified, as also the greater or less facility (if possibility there be) of removing these impediments. If it be owing to want of timber for the construction of boats, may not this be floated from places near the source or by means of some of the higher affluents. If, owing to ignorance, or indifference, or the ferocity of some of the bordering tribes (in uncivilized countries), may not these disadvantages be overcome, and how?

How far does the general wealth and well-being of the borderers, or of the country at large, suffer from the want of a more active navigation of the river, and what would be the probable consequence of an extensive navigation?

If the river be not navigated, but is, or may easily be rendered navigable, specify for what kind of boats, for what distance, and at what seasons, detailing all the facilities existing, and the obstacles that may be removed or diminished, together with the nature and advantages of the commerce that might be carried on by the river, and the probable result for the civilization of the natives, in savage countries, or for the increased comfort and well-being of the people in civilized nations.

It may be here remarked, that river navigation is particularly advantageous to a country where, forage being scarce, and consequently dear, transport by land carriage is expensive. In highly civilized countries, internal navigation, of which river navigation forms a part, is generally in direct proportion to the extent of their inland and foreign commerce.

With regard to the form and size of boats and barges, they are different in different countries; but their construction is in general regulated by the particular nature of the river on which they are intended to ply, and the kind of merchandise they are destined to transport. Thus, shallow rivers, or those which contain many shoals, particularly shifting ones, require the boats to be shallow and without keels. The same construction is necessary when the boats are to be dragged by men or cattle, in order that they may approach the sides. This is a kind of construction which rarely allows the use of sails, unless with a very light wind, or one that blows upon the quarter, as such boats easily upset. When the merchandise to be transported is light, the barks will require to be large and roomy, in order that such a quantity at a time may be transported as will bear the expense of freight. This remark of course applies

only to such light merchandise as cannot be compressed into little space without injury. Rivers that are themselves narrow, or that have many narrow passages, require that the boats should be narrow in consequence; in which case, they are generally longer in proportion. Sails are almost useless in very winding rivers if narrow; in rivers that are very large, on the contrary, they may be used with great advantage, as the breadth of the stream allows of tacking when the wind is contrary.

Much of the value of the foregoing observations, though they should in no case be neglected, is diminished by the facilities now afforded by steam navigation. When the capabilities of a river are considered with a view to navigating them by steam, it will be necessary to note the quantity and kind of fuel which may be obtained along the river, with the facility or difficulty and expense of obtaining it. Is there anything peculiar in the quality of the water that is injurious to durability of either wooden or iron vessels?

Fertility occasioned by the river.—The vapours drawn up from a river are more or less abundant according to the habitual warmth and siccity of the atmosphere; but when the weather is calm, there is generally a much greater humidity directly over and in the immediate neighbourhood of a river than elsewhere; hence the vegetation on the borders of a stream is generally fresher and more luxuriant than that at a greater distance. In well cultivated countries, however, this is not so perceptible; but there are, on the other hand, many regions which, except immediately along the water-courses, are condemned to barrenness and sterility. It occasionally happens that one side only of the river is benefited by the moist atmosphere; the cause of which, if examined into, will generally be found to be the direction of the prevailing winds, which, when they blow habitually across the river, carry the prolific moisture all to one side. To the same cause, independent of any other influence, such as that of aspect or soil, may often be attributed the difference in point of fertility of the heights bordering wide plains.

It sometimes happens that the nature of the cultivation along the borders of a stream is such that the gentle moisture of the atmosphere and the rains which fall are not sufficient in quantity, or the latter, not always to be depended upon. In such case, recourse is had to artificial irrigation, which see, SECTION AGRICULTURE.

Periodical inundations are sometimes highly favourable to agriculture, but of this we have already spoken.

Of a River as a moving power for machinery, &c.—The now almost universal application of steam throughout Europe, has greatly superseded the use of water as a first mover; nevertheless, water is still employed in many places for giving motion to machinery, either because the establishment of steam-engines would be too expensive, or because combustible is scarce, or, finally, because water power is simple and all-sufficient for certain purposes. All over the East, as in Persia, India, and particularly in China, water is much employed as a moving power, as also in the interior of Russia. Generally speaking, water is the prime mover in all mountainous countries, because there natural falls are abundant. Everywhere it is observable that the greater number of mills, &c., are placed along the smaller watercourses, either because these are in the higher levels of a country, and therefore have more fall, or because the water of small streams is easily formed into reservoirs by damming. This latter consideration induces us, in the present instance, not to confine ourselves exclusively to what we term a river, but to include, with the river itself, all its affluents.

Wherever the water of a stream is dammed up so as to form a reservoir, and obtain a fall to be used at pleasure, care must be taken to notice the way in which the dam is constructed and the materials employed. These latter may be piles and planks, fascines, turf, earth and gravel, or even sand, with or without paved, sodded, or clayed surfaces; or they may be formed wholly of clay or of masonry, as bricks, hewn stones, rough stones, &c. What are the precautions taken against the undermining or erosion of the barrier, or against the percolating of water? What are the dimensions of the dam in height, length, breadth, and slope; and what is the medium height of water it has to sustain? How are the sluices constructed, and by what contrivance are they opened and shut? Are any means adopted, and of what kind, for letting off the superfluous water in times of flood? Is the embankment, dyke, or barrier used, as is often the case, as a road across the stream? if so, is it practicable for foot-passengers only, or for cattle and wheeled carriages? Are any means resorted to, and what, for clearing the bed of the pond, formed by the dam, from the mud and silt, which, by raising the bottom, would soon raise the surface of the water to an inconvenient height? Is the

water made to fall upon a wheel, in which case it is said to be overshot, or does it impinge against the lower part of the wheel when it is said to be undershot? The construction of wheels is generally different in the two cases.

When mountain-streams are constant, and furnish a sufficient quantity of water, there is generally no necessity for forming a dam. In such case, a simple channel is cut, or a trough made, to convey to the wheel just so much water as is required, the quantity being regulated by a sluice. Sometimes a sufficient fall is obtained by taking the water from a great distance up a stream, and conveying it far from the river by a mere channel excavated in the soil, or by a simple aqueduct of wooden troughs, or by some more substantial construction.

On large and rapid rivers, it is sometimes sufficient to moor a floating mill in the stream, the current of which turns a paddle-wheel. In some cases a weir is constructed in the river, which, by narrowing the bed, gives greater velocity to the stream. In a word, running or falling water may be applied in a variety of ways as a moving power, and for different purposes: it is made to turn the wheels of flower-mills, bark-mills, fulling-mills, and saw-mills; for setting bellows in motion, and forge hammers, &c.; it is also employed for raising water, whether for the purpose of draining or irrigation, &c. In all cases the traveller should observe to what extent this power is used, for what purposes, and in what way; noting, in detail, everything which this object may present of particular interest.

Of a River as a Reservoir for feeding Canals.—In the case of a projected canal, a person, who was opposed to canals in general, once asked, in a petulant tone,—"Pray, why has Providence supplied us with rivers?" whereupon the canal projector replied,—"To furnish water for canals;" and, indeed, with the exception of some of the larger rivers, there are few that are conveniently navigable for any great distance from their mouth; so that, were it not for canals, inland navigation would be greatly restricted, and the passage from one hydrographic basin to another an impossibility. Rivers, it is true, may be rendered navigable; but the operation is tedious, difficult, and often more expensive than the construction of a canal; besides, rivers, even when rendered navigable, are very likely to get out of order, and, after all, confine the navigation to the natural water-course, which very frequently is not the most desirable line of communica-

tion. But, though not navigable themselves, rivers are of great importance as reservoirs for supplying water to canals. Whenever, therefore, a river is or may be turned to important account in this way, the traveller must not fail to note the circumstance, though, as the details belong rather to canals than rivers, we shall not say anything about them in this place.

Fish and Fisheries.—Almost all rivers contain fish in greater or less abundance, and in many cases the river fisheries are an object of primary importance. On this subject the following observations must be made:—Are the fisheries extensive, of a middling degree of importance, or altogether insignificant? What are the different kinds of fish that are procured, the relative, and, if possible, the positive, quantity of each kind, and its peculiar quality? Is the river remarkable for the production of any particular species of fish not to be found in other rivers of the country, or in other countries? If the fish are of the same kind as are met with elsewhere, are they remarkable for differing, in size and quality, from those in other places, and is this difference in favour of or against the fish of the river under consideration? To what extent, proportionably with other articles of food, is fish consumed by the inhabitants? Is it with them an object of traffic or commerce, and, if so, who are the purchasers? What is the ordinary price of the different kinds of fish on the spot? What number of persons are employed in the fisheries of the river, and how many boats? What is the fishing-season, the construction of the fishing-boats, their load, and the methods of catching the fish? Are the fisheries of the river a monopoly; are they farmed, and, if so, at what rent; or is the fish of the river common property?

Amphibious Animals.—Does the river contain any amphibious animals, and, if so, of what kind? specifying them by name, and giving some idea of their abundance. Of this class of animals some are useful as food, as the fresh-water turtle, and others for their furs, as the beaver, &c. The latter are particularly valuable, and it would therefore be proper to state whether or not they are taken for the sake of their furs, and whether the apparent abundance of them be such as to render it desirable that establishments were formed, or parties organized for the purpose of taking them.

Aquatic Birds.—These are often an object of importance, either as food or by reason of their plumage. The traveller

must therefore note the different kinds of aquatic birds which frequent the rivers and their relative abundance, as also whether or not any use is made of them by the natives, and what. If certain kinds appear only at certain seasons, state when and whence they are supposed to come, and how long they remain.

Pearls.—Some rivers have muscles which furnish pearls in abundance, and though generally not so fine as sea pearls, they are occasionally of tolerably good form and colour, and, consequently, of some value. An observation on this subject should not be neglected.

Minerals.—The alluvial soil of rivers should always be carefully examined by the traveller, for it may contain treasures or interesting minerals of which he is not aware; besides, it sometimes affords indications of mineral wealth in the part of the country where the river has its source, and may hence lead to valuable discoveries. Thus there may be found gold-dust, gems, stream-tin, magnetic iron-sand, &c.; nay, the very sand itself, if of a pure homogeneous and transparent white quartz, is of value as an ingredient for the manufacture of glass. It most frequently happens, however, that river sand is a mixture of various triturated minerals.

Quality of the Water.—Nature, who, no doubt, intended the waters of rivers to be drinkable by men and other animals, has qualified them accordingly; so do we find river water in general to be both agreeable to the palate and the most salubrious of beverages. Nevertheless, some rivers contain extraneous substances, either chemically combined or mechanically mixed, which render them more or less unpleasant to the taste, and produce disagreeable, if not dangerous, effects on the system. Thus, some waters are brackish or saline, some ferruginous, and others acidulated. Generally speaking, these qualities are seldom strongly marked, and are only detected by chemical analysis.* But, as very minute quantities of certain substances act with great energy upon the system, though not sensible to the palate, it would be well, whenever any endemic peculiarity in the health of the inhabitants is observed, which is attributed to, or may be suspected as resulting from, the use of certain waters, to analyze the same, if possible; if not, some may be brought away in well closed bottles, to be subsequently examined. Some waters are observed to act with great energy on

* See OPERATIONS.

those who drink them for the first time, though chemical analysis can detect nothing in them capable of producing the evident effect ; in all cases the particular quality of the water must be mentioned.

As to the impurities merely held in suspension or mechanically mixed in river water, they easily subside of themselves, or may be precipitated or got rid of by filtration ;* it is therefore needless to dwell upon them ; but the fact should be noticed.

Colour of the Water.—It is remarkable that many waters, though beautifully clear, transparent, and agreeable to the taste, are coloured when seen in a large body ; nor has the phenomenon been satisfactorily explained. Thus several rivers of South America are observed to be of a coffee colour when viewed by reflection, and of a fine yellow when seen by transmission; the waters of the Rhone, near Geneva, are of a fine blue, &c. Whenever the traveller, therefore, meets with coloured waters, which are not indebted for the tints they present to the presence of insoluble matter, nor to the colour of the soil seen by transmission, the fact must be noticed, and attention paid to the degree of transparency, the taste, and the smell of the water.

It not unfrequently happens that the waters of a recipient and its tributary stream are of different colours, and that each may be distinctly traced long after their confluence ; this is the case with the Monengahela and the Allegany, and several others. In such case, it is highly interesting to note the distance to which the waters flow in contact without commingling, and the difference, in this respect, which is observed to result from the increased quantity of water and rapidity of course in certain seasons.

Transparency.—There is great difference in the transparency of water, though the degree of purity may be the same, nor is this easily accounted for. Wherever water is so particularly transparent, as to admit of our seeing distinctly objects at a great depth, it will be interesting to measure, as exactly as possible, the degree of such transparency.—*See* OPERATIONS.

Temperature of the Water.—The temperature of large masses of water, as compared with that of the air, is an object of great interest, and consequently deserving the attention

* See Section OPERATIONS, for the various methods of clarifying water.

of the traveller. He should therefore observe the temperature of the water at the surface of rivers, as compared with the temperature of the air at the same time, and this by night and by day, at different hours and seasons. He must also observe the difference of temperature at different depths, in the deeper parts of the stream, and compare the surface temperature of the water in the deep and shallow parts ; and where there are cataracts and rapids, he will do well to mark the temperature immediately above and below the fall.

It is customary to compare the temperature of the surface water with that of the air immediately over the water, but as this air itself has its temperature modified by the state of the water over which it floats, it will be well, if possible, to compare its temperature with that of the air at some distance from the river.

The circumstances of wind or calm, as influenciug the process of evaporation from the surface of the water, and consequently its temperature, must not be overlooked ; and the direction and quality of the wind, as dry or moist, hot or cold, gentle or violent, must be attended to.

The transparency of the water may have some effect in modifying its temperature. The more transparent, the less will the surface water be heated by the sun's direct irradiation, and to the greater depth will the mass be found heated by the sun's rays. For the means of taking the temperature, see OPERATIONS.

Remarkable Peculiarities.—We have already spoken of the subterraneous course of rivers which is unquestionably a singularity, but several other remarkable circumstances may be presented by rivers; among these, we may enumerate the following :—

Extraordinary Bends, in which, after a great length of circuitous route, the river returns to within a few yards of itself. The subsequent wearing through of this narrow isthmus, and the consequent formation of an island, or the eventual abandonment of the ancient winding channel, for a more direct and shorter one; as also the influence of this change upon the rapidity of the current.

Convexity of Surface.—In broad and rapid rivers the surface is sometimes observed to be very considerably curved, the water being much higher in the middle than at the sides.

Change of Current.—Thus, it is said, that in the Ohio the

strong current (the *fil de l'eau*) which, in the day time, hugs one or other of the banks, quits them at night, and preserves the mid channel.

Natural Bridges are also among the curiosities worthy of notice, as are also the—

Gaps or Narrow Rocky Passages through which the river may be presumed to have originally forced its way, and subsequently hollowed out its channel.

Junction of two hydrographic Basins.—Few things are of more importance than the junction of two hydrographic basins by a natural canal, as those of the Orinoko and the Amazons by means of the Cassiquiari. There are two or three similar cases known, and probably more may be discovered. It is not improbable that, at a former period, the phenomenon was more common; any traces, therefore, of such a state of things are highly interesting. Even at the present day there is sometimes a water communication from one basin to another at certain seasons of the year only, and there is little doubt but that, in some cases, the water passage might be rendered permanent, and thus the delay and difficulty of portage be avoided.

These different singularities, and generally every thing, really uncommon, should be noticed and detailed by the intelligent traveller.

CANALS.*—Canals may be divided into three classes according to their particular object, thus there are, 1st, canals of navigation, which may be subdivided into four kinds, according as their object is; *a*, to shorten distances, *b*, to avoid places of dangerous or difficult river navigation, *c*, to connect, and thus continue a line which otherwise could not be navigated in its whole extent, or, *d*, to effect a communication between different hydrographical basins; 2dly, canals for drainage; and, 3dly, canals for irrigation. On canals in general the following observations should be made: the name, and reason of this name; the kind of canal, that is, the particular object for which it was constructed, and if this object be fully attained or not; the pre-

* Canals do not form any part of the natural hydrography of a country, they belong strictly to its industry; nevertheless, as it is particularly interesting, both in a physical and economical point of view, to know what portion of the whole surface of a country is covered with water; canals may, on this account, be placed here. The reasons for the plan we have adopted in the arrangement of our matter have been already given.

cise indication of the spot where the canal begins and where it terminates; its direction, its length, its breadth at the water-line, and at the bottom, in different parts of its course; its depth; the nature of the soil in different places; the embankments, revetments, &c., with their materials, dimensions, and mode of construction; the number of locks in the different parts, with the height of the falls, taking care, at the same time, to pay special attention to the construction of the locks and their gates, more particularly if they present anything new or ingenious; and if there be any contrivance by which to diminish the quantity of water necessarily lost in the passage from one level to the other. Are there any inclined plains by which the passage from one level to the other is effected? and, if so, observe them minutely, and the means employed for raising and lowering the boats. Are there any subterraneous passages or tunnels on the line? if so, mark their situation, length, construction, and manner of lighting and ventilating. If there should be any aqueducts, notice their situation, height, length, and construction. Are there any sluices? where? how are they constructed, and for what purposes? for irrigation, for the supply of towns, or merely for carrying off the superabundant water at particular seasons, or under particular circumstances? How is the canal supplied with water? Has the construction of the canal been attended with any particular effects on the adjacent lands? Sometimes, to a certain degree, they prove detrimental, as in the case of the canal at Languedoc, in France, when it was observed that the felling of the woods, which that great work rendered necessary, had dried up the springs and rendered the soil arid, besides giving passage to those violent sea winds called *Mistral*, before unknown in the country. Sometimes a canal, independent of its particular object, acts as a beneficial drain to the wet soils through which it passes. Indeed, some canals are undertaken, from the first, for the double purpose of drainage and transport.

Who was the projector of the canal, and who the engineer under whose directions the works were carried on? How long was the canal in constructing; at what and at whose expense? Were there any remarkable difficulties in the construction of the canal, and how were they overcome? Has the canal met with any extraordinary accidents since its construction, of what kind were they, when did they happen, how and by whom were they repaired, and at what

expense? What is the expense of annual repairs and attendance?

As for navigable canals in particular, it is necessary to ascertain the kind and the number of boats which navigate them, with their tonnage and the number of persons employed on them, and the number of horses or oxen used for towing, if they are not sailing boats, which is sometimes the case. (Egypt.) What are the towns, halting places, markets, and wharfs, &c., on their banks? What is the nature of the traffic carried on by means of the canal, the annual quantity and value of the goods transported, and their respective ulterior destination, the rate of going, and the freight for different kinds of merchandise, at different seasons? Is the canal navigable the whole year round, and, if not, what causes the impediment, is it the ice of winter, or the want of water in the summer? For how long is the navigation interrupted by these causes? Does the canal belong to the government, to private persons, or to a company? In either case what is the presumed profit of the proprietors? What may be remarked as peculiarly praiseworthy or defective in the regulations of the navigation of the canal and the keeping it in repair? Do passage-boats of any kind ply upon the canal, and, if so, between what places? What is the rate of travelling, the passage-money and average number of persons annually going by such conveyance? What remarkable effects have been produced, particularly along the line of the canal, by its construction; and what general effect has it had on the commerce and wealth of the country? If there are any dues paid to the state, how are they fixed and levied, and what is their annual amount?

With regard to canals for draining, besides the general observations already mentioned, the traveller should ascertain what quantity of land has been reclaimed by this means. Is it possible to ascertain the total amount of benefit conferred upon the country by such canals? What were the diseases which prevailed when the district was covered with stagnant water, and which are no longer known, or greatly diminished since the draining has been effected? As to the operations of draining, they are very important, and are effected in various ways. Drains, properly so called, are frequently covered; and often, when open, are little more than mere ditches. But of drains and draining we shall speak again. See AGRICULTURE.

Canals for irrigation are sometimes very long, and branch

off in all directions; in this case, it is generally the main trunk only which deserves the name of a canal. Its several dimensions must be observed, as also the extent of land watered by its means; the source whence, and the mode by which the water is obtained, &c.

LAKES.—Lakes are collections of water of greater or less extent, sometimes giving rise to rivers, sometimes receiving them, and sometimes situated in the direction of their course. Some lakes neither receive any rivers, nor have any issue; the former are usually small. Lakes are occasionally called seas, but not solely in consequence of their magnitude; thus the great American Lakes are not called seas, while the small Lake Asphaltite is designated by the appellation of a sea; and the Lake Aral is also called the sea of Aral: the Caspian, though a lake, is called a sea.

It has been thought, bacause the Aral, the Lake of Zorrah, and some others which receive rivers while they have no outlet, are salt, that all lakes, so circumstanced, must be salt likewise; but as this is by no means generally the case, and as many salt lakes have neither affluents nor outlets, their saltness must be due to some other cause. But if, as is certainly sometimes the case, the rivers disemboguing into lakes without issue, bring into the recipient, and there depose saline substances, these lakes should become annually more salt.

With regard to lakes in general, the observations to be made upon them may be comprehended under the following heads:—

Name; geographical and topographical situation; height above the level of the sea, and as compared to other neighbouring lakes; form, length, breadth, circumference, surface, and depth; the nature of the bed and of the borders; the transparency, colour, temperature, and quality of the water; the affluent streams and springs; the outlets, the currents; the climate, soil, and vegetation of the basins; the height and nature of the surrounding hills, when there are any; the prevailing winds; the mean ratio of evaporation, compared with the quantity of water supplied; and any particular phenomena; the navigation and fisheries of the lake, &c.

Name.—Note the name or names by which the Lake or any particular portion of it, is now, or was formerly, known.

Geographical Situation.—This should be indicated as

comprised between certain degrees of latitude and longitude; the latter, reckoned from the meridian of Greenwich. When lakes are small, it will be sufficient to give the lat. and long. of some particular part of the lake, only stating precisely which part, as for instance the point where the principal affluent comes in, or the place of the immediate outlet, and the bearing of this point from the middle of the lake.

Topographical Situation.—This refers particularly to the part of the country or province where the lake may be situated, or to the region in which it may be placed; as in the hilly, woody, barren or cultivated district, in a plain, in a valley, or on a height, or its nearest distance and bearing from the sea, from some other lake or remarkable place.

Height above the Sea.—This should always be ascertained if possible, as, together with other data, it serves to explain many of the phenomena of lakes. Should there be two or more lakes in the vicinity of each other, their relative height should also be obtained.

Subterraneous Communication.—Is any such known to exist, or are there any reasons to suspect such communication, and what?

Form.—The form of lakes may be at first supposed an object not worth observing, but it has its importance; for it is evident that, unless in the case of a bed mathematically regular both as to contour and slope, every change in the quantity of water will induce a change in the contour of the lake; so that any remarkable change in this latter is a positive indication either of rise, or fall, or displacement; all of which changes are highly interesting. In lakes of very irregular form, the change in the contour generally gives the first notice of increase or diminution of the water of the lake, which in very regularly formed sheets of water, is not so soon observed. In general, the length and breadth in one, two, or more places, as the case may require, are sufficient, with the terms long, narrow, oval, round, square, &c., to specify the form. But there are cases in which a longer description of form is necessary. In some few instances, as in that of the Saïma, in Finland, the irregularity of form is such as to defy all description. Nothing, in such a case, can be perfectly satisfactory but an exact plan, and this, from the very irregularity itself, can hardly be given but by an operation requiring too much time for the traveller to devote to so special an object. When a plan cannot be

taken, travellers will do well to liken the form of the lake to that of some well known object, which he may easily do, if he can obtain a general view of it from some eminence.

Length, Breadth, and Circumference.—The line according to which the length of a lake should be taken, is not always so easily determined as might be supposed. The top or head, and the bottom of a lake, may be supposed the natural longitudinal extremities, and so they are in some cases, as in the Lake of Geneva, for example; but the question arises, what determines the top and bottom of a lake? certainly not always the point of influx of the principal affluents, and the place whence the outlet issues; for sometimes both, or one of these, as in the Baikal, will be found on the side of the lake, and sometimes very near each other relatively to its length. And again, even when the head and bottom of the lake are determined, how is the line to be measured between them? certainly not always in a straight line, for if the lake happened to be in the form of a crescent, as the Lake of Geneva just mentioned, or of an S, such a line would pass over the land. The breadth is no less a matter of difficulty than the length; for by the length is always understood the extreme longitudinal dimension; but the breadth generally means the medium width, unless otherwise expressed. Now, in irregularly formed lakes, the medium breadth is not easily ascertained; nor is there any rule regarding the places whence, and the direction in which, the breadths should be taken. As for the perimeter, it is in some cases easily obtained, and in others is very difficultly ascertained, either by reason of its great irregularity, or from the nature of the banks, which may be swampy, or otherwise of difficult access. But as there is altogether much uncertainty regarding the best mode of obtaining the length, breadth, and circumference of lakes, and as the methods employed are not only arbitrary, but frequently very unsatisfactory, we venture to recommend the practice indicated in the section entitled OPERATIONS, (which see.)

Surface.—The extent of surface of a lake is an object of considerable importance; indeed, it is principally in order to obtain this as exactly as possible that it is recommended to take the length, breadth, and circumference. The quantity of moisture given out by evaporation is *cæt. par.* in exact proportion to the extent of surface. Hence, knowing the quantity evaporated from a given surface, in a

given time, at particular seasons, or taking the mean of the year, the quantity evaporated from the whole lake, its surface being known, is easily estimated. For the method of ascertaining the ratio of evaporation, see OPERATIONS.

It is, therefore, necessary to observe what is the extent of surface of the lake in square measure. Is that extent subject to annual variation; and if so, to what extent, and at what times of the year? To what cause or causes is such variation to be attributed? Has the superficial extent of the lake been observed to increase or decrease regularly, independent of periodical changes, for any number of years? If it be on the decrease, can any probable estimate be made of the time required for the total annihilation of the lake? What are the annual variations in the level of the surface?

The horizontality of the surface also should, if possible, be ascertained! for although the surface be generally horizontal in stagnant water, it is not always so in lakes having an outlet, the water at the latter point, or in some other part, being sometimes considerably lower than at the point of confluence of the principal affluent. The slope is sometimes continued the whole way, and sometimes the depression extends only to a certain extent back from the outlet. The surface of the slope is generally a curve.

Depth.—What is the depth of the lake at various places, and its medium depth? It is particularly recommended to take, if possible, correct soundings over the space immediately in front of the various affluents, in order to ascertain the extent of their alluvial deposits at the time, so that by a comparison with this and what it may be at some future period, an estimation may be made of the quantity of sedimentary matter annually brought into the lake.

Nature of the Bed and Borders.—The form of the bed, inasmuch as it is regular or uneven, is ascertained by the soundings, which also indicate whether the deepest part is in the middle or on either side. The sounding lead will also indicate the nature of the bed, as rock, gravel, sand, clay, mud, &c.

What is the form and character of the borders? Are they high and steep, or sloping, or shelving; are they rocky, and if the rock be stratified, what are the strike and dip of the strata? Are they of indurated clay, or earth, or chalk, &c.? and if abrupt, are they, as is generally the case, subject to falling in, in consequence of the erosion at the water-line? Is the quantity of land thus annually destroyed of any

extent? Is there any extent of sandy, gravelly, or shingly beach between the high banks and the water's edge? Are there any boulders or erratic blocks, and if so, what is the nature of them, and are they of the same rocks as those *in situ* round the lake, or on the course of the rivers or torrents which fall into it, or different? are the banks clothed with vegetation, and of what kind? In extensive lakes the borders are generally different in different parts, this circumstance should be noticed.

*Transparency and Colour.**—What is the degree of transparency of the water, and what its colour? With regard to the latter object we may remark, that some waters seem to have a constant tint of their own, while, in most cases, the colour varies with circumstances. Much of the tints of water in large masses depends upon the depth, the colour of the bottom, the shadow of surrounding objects, the reflected light, &c. In speaking of the colour of the water, it must always be stated whether it be that of the pure unmixed water, or derived from clay, or sand, or other substances held in suspension.

Temperature.†—The temperature of large bodies of water is a subject of considerable interest in general physics, the more particularly as it tends to throw some light upon the difficult problem of the internal temperature of the earth; so do we find that intelligent travellers have ever considered this subject worthy their attention. Few, however, either for want of time or means, have done more than plunge a thermometer into the surface water; but this is not sufficient: the temperature should be taken, as we have already indicated in speaking of the temperature of rivers, at all depths, in all parts, and at all seasons.

The laws which regulate the temperature of water are very differently modified in the case of lakes from what they are in that of rivers. Water is a bad conductor of heat, and hence the comparatively stagnant water of lakes requires a much longer time to have its temperature modified than the water of rivers, which by reason of its motion mixing the colder and warmer portions together, is generally found to have its temperature more rapidly changed, and to vary less at different depths. The temperature of lakes depends on the combined influence of three several circumstances, viz., the temperature of the atmosphere, the depth, and the tem-

* See OPERATIONS. † Ibid.

perature of the affluents, when the lake has any. Thus it is evident that a lake which receives the ice cold water of thawed snows and glaciers, will be generally much colder, at certain depths, than lakes otherwise circumstanced, and the difference between the temperature of the surface and the lower water will be found very great in the summer; for the same atmospheric heat which warms the surface, produces the cold water we have mentioned by melting the snow, and hence the data regarding the temperature of lakes is incomplete if the temperature of the tributary waters, at their influx, be not ascertained. Anomalies are sometimes met with, for which it is difficult to account. These may, perhaps, be generally attributed to deep-seated springs which empty into the lake, and whose waters are warmer according as they are at a greater depth below the surface of the earth. Thermal springs, of course, greatly modify the temperature of lake-waters, but these are, comparatively speaking, seldom met with unless in volcanic countries.

As connected with the temperature of lakes, their freezing, when they are subject to congelation, must be attended to. What are the usual periods of freezing and thaw and the thickness which the ice attains? Should the lake be in a situation when it would naturally be supposed to freeze, and yet does not, the circumstance is probably owing to great depth, or to a warm spring. When the surface freezes, are any particular spots observed to remain always unfrozen, or to freeze much later than the rest, in either case, what is the probable cause of the singularity.

*Quality of the Water.**—Lakes have been divided into fresh and salt water lakes; but between the freshest and the most salt, the gradations are sometimes insensible, nor can the taste alone be at all times depended upon. When a traveller has been long accustomed to putrid and brackish water, any that is comparatively free from smell and less salt, appears to him perfectly fresh, and thus he says that in such a place there is a lake of fresh water; whereas a palate used to water really fresh would find this very salt, or bitter, or otherwise disagreeable. This is one of the many cases in which no positive information can be derived from mere sensation; it becomes, therefore, necessary to make at least some slight trial of the quality of the water, the *modus operandi* for which is given in the section OPERATIONS.

* See OPERATIONS.

Having obtained approximately, or with exactness, the quality of the water, it must be stated, and, if possible, accounted for; and should the lake be decidedly a salt-water lake, it will be well to ascertain, if possible, whether the water has become regularly more or less salt within a given number of years. The impurity of lake water may be derived from three different sources, viz., the impurity of the affluents, either superficial or subaqueous, which empty themselves into the lake; the nature of the soil of the bed of the lake itself, or of that in its immediate vicinity, as containing a greater or less abundance of soluble matter; and the more or less perfect renewal and change of the water. Impurity from stagnation, however, can hardly ever be the case in those large masses of water worthy of being called lakes. Independent of the quality of the water, as ascertained by experiment, the taste and smell should be mentioned. Singularities of quality, as when the water has an incrusting or a petrifying property, &c., are mentioned under the article *Remarkable Phenomena.*

Affluents.—Besides the rain and snow which falls immediately into the lake and the direct superficial drainage of, and infiltration from the surrounding soil, the lake may be supplied by tributary streams, such as torrents, small streams, or large rivers; by any two, or by all three, of these different kinds of affluents. The names, number, nature, and position of these must be specified, together with every circumstance connected with them and with their embouchures which immediately influences the lake; above all, the annual quantity of water supplied, and the quantity of débris brought into the lake, with its nature and the manner in which it is deposited, must be noted.

Outlets or Effluents.—Of lakes that have visible outlets, some have but one and others have several: in some few cases, the outlet of a lake is subterraneous, and, consequently, invisible. Of visible outlets, notice, in the first place, how many there are, and the precise situation of each, as also its position with reference to the rest and to the affluents of the lake. Upon every separate outlet the following observations should be made. Is the outlet of ancient, or, comparatively speaking, of modern formation? What are the evidences of the former case, and in the latter, does the outlet appear to have been formed suddenly, or by imperceptible degrees? What is the quantity of water annually discharged by the outlet? How is it discharged, slowly or precipitously? What is the nature of the soil at the

outlet? What are the dimensions of the outlet in breadth and depth, what changes are now taking place in these dimensions, and does the outlet increase more in width than in depth, or the reverse? Has the position of the outlet retreated towards the lake, and, if so, how much in a given time? Are there any indications at the outlet, of the water having been formerly at a higher level, and what is the height of the marks above the present surface of the water at the outlet? Is any shoal formed in the lake immediately behind the outlet, or elsewhere near it, and, if so, what is the cause of this, and the effects likely to result from the increase of the shoal? What is the depth of water immediately behind the outlet as compared with the depth in other places? What is the temperature, colour and transparency of the water at the outlet as compared with the water of the lake and with that of its affluent or affluents? Is there any indication of more or less water being discharged now from the outlet than formerly, and, if so, to what circumstance may the change be attributed? Is it possible to form any tolerably correct estimate of the time when the outlet will be worn down to a level with the bottom of the lake, or when, from causes now in action, the lake will cease to have an outlet. Is the outlet navigable, or is the passage rendered difficult, dangerous, or impassable, by reason of rapidity of the current, of rocky obstructions, of whirlpools, or from any other cause?

Currents.—Lakes without either affluent or outlet are usually small, but even if large, they can have no currents but such as are temporary and produced by wind; whereas lakes that have one or more affluents without outlets, or one or more outlets without an affluent, and still more, such as have both affluents and outlets, have always currents, though, in some cases, hardly perceptible. When a lake has one affluent of considerable size (for we do not here consider the little rills which may trickle down into a lake) and no outlet, the current produced in it will have its direction, its strength, and the distance to which it extends modified, first, by the volume of water poured in by the affluent, as compared with the dimensions of the lake; secondly, by the situation of the affluent; and, lastly, by the difference, if any, which there may be in the specific gravity of the water of the affluent and that of the lake. The lake having no outlet, any current in it will probably be accompanied by a counter-current, unless the inflowing waters

arrive gently, and spread very slowly over the surface. The current itself may, for instance, run along one side of the lake, when the counter-current will run along the opposite side; or the current may be central, with two lateral counter-currents; but should the water of the affluent be much heavier, from a much lower temperature, than that of the lake, the current will be an under-current, and the counter-current, if there be any, will be an upper or superficial one. A lake having an outlet, whether it have any affluent or not, must of necessity have a current, and it will depend upon the form and contour of the lake, whether or not any counter-current be formed by such of the waters as, proceeding towards the outlets, cannot at once effect their escape. It will be easily conceived that when lakes have both affluents and outlets, there will be a combination or conflict of currents, which in large navigable lakes, sometimes produces eddies that are worthy of attention. Whenever lakes without an affluent or outlet are observed to have currents not occasioned by wind, the cause may perhaps be the existence of a subterraneous affluent or outlet, or both. The currents of lakes, then, are worthy of the traveller's attention, as curious facts of physical geography, if they be not, as they sometime are, important as connected with lake navigation. Observe, then, the strength of the currents and counter-currents, their direction, and the distance to which they are sensible, the difference occasioned by the seasons, and the effects of particular winds. Observe, also, if there be any difference in the temperature of the water of the currents and that of the more quiescent parts of the lake, or between the different currents themselves.

Remarkable Phenomena.—Among the remarkable phenomena presented by lakes, we may enumerate, remarkable colour, or coloured spots, extraordinary transparency, immense depth, floating islands, double bottoms, freezing in summer, remarkable noise produced by throwing in a stone, tingeing or other remarkable property of the water, periodical rise and fall, subaqueous winds, frequency of waterspouts, seiches, rumbling noise, flowering, rapid diminution of surface, declivity of surface, concentric stripes, emission of gases, attractive power of the bottom, &c. Of every one of these peculiarities there are examples; the traveller will, therefore, be careful to notice such whenever he may have an opportunity, taking care to describe exactly all the appearances, together with every thing connected

with them which may tend to the explanation of their causes.

Navigation.—Large lakes are of great importance as affording an easy mode of communication from one part to another of the countries situated on their borders. Every thing, therefore, should be noted relative to the navigation of lakes. What are the several anchorages, ports, places of embarkation and debarkation on the lake? Have these latter any jetties or quays? and, if so, describe them. What number of vessels or barks may be sheltered in the several ports against the storms or strong winds of the lake? What number of vessels belong to each separate port, and of what kind are they? that is, what is their tonnage and construction, and how much water do they draw? What are the usual trips that are made respectively to and from the different ports on the lake? What kinds of merchandise, provisions, building materials, &c. are transported by the lake navigation? Do any steam-boats ply upon the lake, and, if so, how many, and of what tonnage? Are there any vessels used for the sole purpose of conveying passengers and luggage? What is the line they take, the usual time occupied on the passage, the accommodation, the fares and customary times of starting? What number of craft of all kinds are upon the lake, and the number of hands employed in the navigation generally? Are the vessels, barges, or boats built upon the lake, and, if so, where are the yards, what is their extent and advantages? Is building timber abundant on the lake, or is it floated down by its affluents, and, if so, whence? What kind of timber is used, and whence are the other requisites for ship-building obtained? Is the navigation of the lake free to all, or is it a privilege enjoyed by one or a few? When the borders of the lake are occupied by different nations, are there any vessels of war upon it, and, in such case, what number of guns and weight of metal do they carry? What batteries or ports are there upon the lake? where are they situated, and what is their strength? Is the navigation confined to the lake, or do vessels come into, or go out from it, by its affluents or outlets? and, if so, whence do they come or where do they go? Are there any buoys on the lake, or landmarks, or light-houses on its shores to guide the vessels, warn them of danger, or point out the ports at night?

Should the lake be navigated only by canoes, describe their construction and burthen; how many there are of

them, how many hands are required to man them, how they are paddled, rowed, and steered, how painted and ornamented? If they have sails, of what kind are they, &c.? Is the navigation ever interrupted by the freezing of the lake, or by particularly stormy weather? in either case, at what seasons and for how long at a time?

Fisheries.—The fisheries of lakes are, in some cases, of very great importance, and even when they are not, they might become so, if the country in the neighbourhood of the lake were better peopled, or if facility of transport and other circumstances rendered it expedient to turn attention to this object. If, then, fisheries are already established, the traveller should note the number of boats and persons employed; the quantity and value of the fish taken, the construction of the boats, and mode of fishing, and the season when the fishing is carried on. Are the fish consumed upon the immediate borders and in the vicinity of the lake only, or is it, or any part of it, conveyed to a distance, if so, to what places, and how? What are the principal fish and their quality? Are the fish cured, and how, or are they eaten fresh? Is the fishing carried on wholly for the fish as food, or for the sake of any particular product which they may yield? In the latter case, what is this product, and how is it prepared? What are its uses, quantity, and value? Is the fish in general found to frequent certain parts of the lake, or is there no difference in this respect in different parts of the lake, or are certain kinds found in certain places and others in other places? Can any reasons be assigned for this? Is the fishery free to all, or is it a privilege, and, if so, by whom enjoyed? Are any duties imposed upon the fishery? is it farmed, &c.

When the lake is full of fish, and yet no fisheries are established, what is the reason of this? and, if it should be desirable to establish a fishery, state why and what would be the best mode of encouraging this kind of industry.

Formation and Dessication of Lakes.—Lakes may have been formed in a variety of ways; thus the water which could not run off after the general retreat of the universal ocean, would form lakes of salt water of greater or less extent; these would diminish by evaporation till the surface became such as that the evaporation and the supply exactly compensated each other. Lakes thus formed must of necessity be more salt from concentration than the waters of the primitive ocean. The same lakes, if an outlet were sub-

sequently made by an earthquake, by the pressure of the water breaking down the barrier, by erosion, or otherwise, would evidently become, in time, lakes of fresh water, from receiving only that which was fresh, while a quantity of salt water was ever running off. The falling in of a cavern may have caused a depression, which, receiving and retaining the drain of the neighbouring country, has become a lake. The damming up of a stream by the fall of part of a mountain, or the interception of its course by a lava current, may form a lake. In a word, the ways in which a lake may have been formed are various, and for the history of the earth it were well if the traveller would endeavour to ascertain what was the origin of the lake he describes.

There are no lakes, perhaps, at the present time, in a state of formation or increase; on the contrary, they are all decreasing more or less rapidly by the filling up of their beds with sedimentary matter, by the enlargement of their outlets, by erosion, &c. Every country abounds with spots which have the appearance of the beds of ancient lakes; indeed, if ever the earth was covered by a universal sea, every hollow must, for a longer or shorter time, have been filled with water.

The fact of the decrease of lakes being certain, the main point is to ascertain, if possible, the ratio in which the progress is going on. This may be approximately ascertained in various ways; the most certain is, to calculate, as nearly as possible, the whole quantity of the supply of water, independent of detrital matter, and the loss by outlets and evaporation. This operation, however, supposes many previous ones which can hardly be performed by the passing traveller. But the resident in the vicinity of a lake, if his other occupations will allow him, may ascertain the approximate ratio of its diminution, and the probable epoch of its ultimate and entire dessication, and thus not only benefit science, but perform, in many cases, a task of important practical utility; for there are ways of retarding the dessication of a lake, and these would certainly be had recourse to whenever, as is too certain in many places, the drying up of a lake was ascertained to be in rapid progress, and the event likely to affect materially the prosperity of the surrounding country.

The present ratio of dessication can, however, furnish no data for ascertaining the state and extent of the lake at any remote period. A close investigation of the heights which

surround and form the basin may sometimes throw light upon the former extent of its waters, as when its rippling at the margin has eroded the rocks in certain places, and thus left traces of the height at which it once stood. When the basin has been partially, but suddenly, emptied at different times, two or three lines of erosion may sometimes be found, though the absence of these is no proof that the water did not once stand at a much greater elevation than at present, for time and the elements may have worn away the marks. The depositions and fossil remains found in the basin may serve to show whether the water was salt or fresh, or whether, though salt itself, it did not, for a long time, continue to receive and bury among its depositions the terrestrial and fresh water animals brought in by a river. The former heights of the lake are sometimes marked by a series of bergs or terraces, ascending like steps all round the basin. These, and similar facts, are highly interesting, and should always be observed by the traveller if he have time, and the preliminary knowledge requisite for this kind of research.

Effect on Health and other incidental Disadvantages.—It is observable that while a single large lake exercises no malignant influence on the health of the inhabitants in its neighbourhood, a number of small ones, near to each other, is unwholesome. This difference is easily accounted for : much, however, depends upon the topographical configuration of the country ; its latitude and height above the sea ; the prevailing winds ; and the wooded or open nature of the district.

Besides influence on health, a number of small lakes have other disadvantages ; they are too small to assist communication by water transport, and they impede land conveyance by the windings they force the roads to take ; indeed the only advantage they present, independent of the fish they may supply, is in forming, to a certain degree, a natural defence against the progress of hostile armies ; but even this advantage depends upon the relative position of the watery district. These, and all similar circumstances connected with lakes, will not fail to be observed by the intelligent traveller.

MARINE LAGOONS.—Immediately after lakes, we may speak of those sheets of water formed naturally by the sea, and from which they are either entirely separated, or with which they constantly or occasionally communicate. They are termed simply Lagoons, but as we have spoken

of *Fluvial Lagoons* in the article on Rivers, we shall, for distinction's sake, call those we are now alluding to, *Marine Lagoons.* The observations to be made on them, are as follow:—

How and when were they formed? What are their dimensions and depth? Are they increasing or diminishing in extent? Are they beneficial or the reverse to the inhabitants? The benefit arising from them is usually limited to the fish, which come into them with the tide when there is a communication, or which breed in them when they are large and without communication: for, as the sea brings in no vegetable humus, there would be no advantage in draining off, with a view to cultivation. Besides, from their very low position, the water could only be got rid of by raising, which is expensive. But if a considerable river, charged, always, or periodically, with a prolific mud, can be made to empty itself into the lagoon, it may, in a few years, be converted into productive land, and secured from encroachments of the sea by a dyke. But these operations involve the expenditure of large capital.

Marine Lagoons sometimes give rise to unwholesome miasmata, when their waters are stagnant. This, however, depends in great measure upon the nature of the soil, the heat of the climate, the degree of saltness of the water, &c. Salt water, on a sandy bottom, is not so apt to become fetid; but if a lagoon of this kind receive the soft water of a number of small rivulets, which bring into it dead and decomposing organic matter, the water of the lagoon will soon become corrupt; and, in this case, should the spot be inhabited, it would be advisable to turn off the fresh water by sufficient dykes. If any such works exist, the traveller should observe them, and how far they have been undertaken with success; or, in the event of failure, to what circumstances such failure may be attributed.

PONDS OF FRESH WATER.—It is not easy to determine the line of distinction between ponds and lakes; for a large pond may be termed, and is often called, a small lake, and a small lake, a large pond. In strictness, perhaps, a pond, whatever may be its size, is merely a hollow filled for the time with the rain water which has flowed into it from the surrounding surface; whereas, a lake is supplied by one or more springs at least. Thus ponds are seldom permanent but in rainy seasons; and lakes, even when small, seldom dry but in uncommon or

long-continued droughts. Ponds are apt to become putrid, and thus taint the air, when they are in great numbers; lakes, on the contrary, from their constant renewal, remain fresh and wholesome, except inasmuch as they maintain a constant moisture of the atmosphere, when there are many close together. Ponds are, of course, most frequent in undulating countries, and are pretty sure indications of a clayey soil.

ARTIFICIALLY COLLECTED WATERS.—Artificial reservoirs belong rather to the industry of a country than to its natural hydrography: but as they are supplied by nature, though collected by art, and as they should be included in all general estimation of the waters of a country, they may as well be mentioned in this as in any other place.

Water is collected and retained in large quantities for a variety of purposes, as for feeding canals, for irrigation, for turning the wheels of mills and other machinery, for the preservation and breeding of fish, for embellishing parks and pleasure grounds, &c. These reservoirs are sometimes of great extent, and when the breeding of fish is their object, they are frequently, if properly managed, a source of considerable revenue. In order to give satisfactory information on the subject of artificial reservoirs generally, their advantages and disadvantages, the following objects must be considered:—Their situation and dimensions; the time, the manner, and the expense of their construction, including the works undertaken in order to bring in the water of springs, rivulets, &c., and the cuts or ditches for collecting the superficial or rain water. How are these several supplies conducted to the reservoir? Are any means adopted, and what, for preventing the waters from bringing with them into the reservoir, detritus of any kind? Has a proper calculation been made of the loss by evaporation as compared with the supply, so as to have at all times a quantity of water sufficient for the purposes intended? If the breeding of fish be the object, what is the cost of stocking with fry? This sum being added to the annual expense for repairs, &c., and deducted from the value of the fish sold every year; what is the net profit to the proprietor, and what would be the profit or loss if the reservoir were drained and cultivated?

It is generally understood that the proprietor of a fish-pond would derive much greater profit from draining off and cultivating; and, consequently, too great a number of

fish-ponds are detrimental to the agricultural produce of a district; but this assertion must not be received without limitation; much will depend on the demand for fish, and the facility with which abundant supplies of agricultural produce may be obtained from more fertile provinces. A more general truth is the unhealthiness they occasion, which is such, in some cases, as to call for the interference of government, to limit the permissions granted for the establishment of fish-ponds.

The small garden reservoirs, ponds, &c., are, in some cases, important, as presenting together a great surface of water; as in the East, for instance, where the practice of having tanks or reservoirs in every garden is general. Whenever this is the case, some notice must be made of the fact by the traveller.

MARSHES.—If, as we have said, lagoons and reservoirs have frequently an homicidal influence, by tainting the air with the fetid exhalations they emit, and are still further prejudicial by reason of the extent of surface they keep from agriculture, with much greater reason may we say the same thing of marshes, though these are sometimes attended with advantages which, to a certain degree, afford a kind of compensation. These advantages may be divided into natural and artificial: the natural benefits afforded by marshes are peat, which they sometimes furnish in great abundance (Holland, Ireland, France, &c.), and which, in some situations, is an object of the greatest importance. Some marshes yield an inferior kind of iron-ore, which may be worked for particular purposes (Lithuania), rarely excellent iron-ore (Siberia). Other marshes abound in wildfowl, and are therefore a great resource to the inhabitants, whether as consuming it themselves, or making it an object of traffic (the Marshes of Tuscany). Leeches are also a production of the marshes, occasionally turned to great account (Poland, France). The rushes, reeds, and willows of marshy grounds, are also important productions (Italy, Holland, &c.).

Of the artificial advantages to which marshes may be turned, the principal is for the cultivation of rice, where the climate is in other respects favourable to the growth of this grain (North America, Hungary, &c.). The humus, dug up from marshes, is, in some cases, an admirable manure. Certain marshes abound in a small kind of turtle or tortoise, which is edible; and others produce a great

quantity of a nutritious aquatic nut, as the *Trapa*, in Russia and in China. Marshes are found in all situations: on heights, on the sloping sides of hills, in valleys, in woods, in the midst of sandy plains, by the sea-side, and in the smaller islands, as well as in the interior of continents. They are sometimes perpetually under water, and sometimes periodically dry; they sometimes give rise to streams, and sometimes receive and absorb them. Thus, in considering marshes, it is necessary to observe their length, breadth, and superficial extent; are they constantly under water, or periodically dry? at what time of the year, and for how long? Are they turned to any beneficial account, and what? Have they any decidedly prejudicial effect on the health of the inhabitants in their vicinity; and, if so, are any means taken, and what are they, for draining off and drying the marshes? or, if drainage be impossible, is the system of dyking and filling up (*colmare* of the Italians, called *warping* by us) pursued; and, if not, might it not be adopted with success? If the time and manner of the formation of the marsh be known, mention them. If the marsh has given rise to no works, is it observed to extend and gain ground; or, on the contrary, to be naturally drying up? does it absorb or give rise to any river, and what? have any fossil remains of animals, of the present or of extinct races, been ever dug up from the marsh; and, if so, of what kind, in what degree of abundance, and in what state of preservation?

Salt-water Marshes differ from ordinary marshes only in the quality of their water and the nature of their vegetation: they are common in some parts of Asia, where the soil is greatly impregnated with muriate of soda and other salts. These marshes must not be confounded with those artificially collected salt waters, called *salt marshes*, the object of which is to obtain sea-salt by spontaneous evaporation; these latter, whenever they are met with by the traveller, should be observed; noting their situation and extent of surface, the means by which the water is collected and retained, the processes of concentration, &c., in order to obtain the salt, the quantity annually produced, and its value; as also to what purposes this kind of salt is particularly applied, where it is sent to, how many persons this industry employs, &c.?

SEAS.—The observations to be made on the sea are of two kinds: first, on the sea as connected with the land; and, secondly, on the sea itself: we shall begin with the first of

these. When a part of the country is bounded by the sea or the ocean, the bearing of the sea with regard to the country must be stated, as this circumstance exercises a most important influence on local climate. What is the length of the coast-line in following its principal bend? What is the form of the coast-line? it may be straight, or concave, or convex, and either of these forms may be entire, indented more or less deeply, or jagged. What is the profile of the coast? it may be vertical, or more or less highly inclined, in which case it is called a bluff or bold coast. According to the nature and undulations of the soil at the sea-line, the coast may present a continued cliff for a great distance, or a more or less regular alternation of bluffs and low parts. Sometimes a bold coast has a beach below, which is uncovered at low water; sometimes the cliffs or crags dip down at once into the water to a very great depth, so that vessels may sail close in. Is the shore shelving? this it may be, more or less; it is sometimes so low as to force even the smallest vessels to keep a great way out. Between the very low shelving coast and the coast formed of lofty and perpendicular cliffs, the gradations are many. If the coast-line of the country be very limited, it may, in its whole length, be of one character; but if, on the contrary, the line be extensive, it will present different characters in different places; this circumstance must be noted, and the several parts distinctly specified. If the coast be bold, what is the nature of the cliffs? Are they of stratified or unstratified rocks? and, if stratified, state the dip and direction of the strata, and the hardness of the rock. Are they of chalk or clay, &c.? If the coast be low, what is the nature of the beach; is it mud, sand, or shingle, with or without scattered blocks and boulders? In a geological point of view, it would be interesting to observe the nature of the sand and stones. Are there any dunes or sand-hills formed upon the coast, and, if so, in what parts? What progress do they make, and in what direction? Have the sands thus blown up on the land invaded any considerable extent of country, and caused much damage? Have any means been devised, and what, in order to arrest their progress? Is any part of the coast subject to inundations from the sea, and, if so, are any methods adopted, and what, to prevent this calamity? Is the neighbourhood of the sea observed to have any particular effect upon the vegetation? In certain cases the spray is carried far inland, to the great detriment, and some-

times total destruction, of the crops. On the other hand, advantage is sometimes taken of the saline atmosphere, which, by impregnating the soil with salt, renders it peculiarly favourable to the growth of such plants as furnish soda.

Is the coast lined with mangroves in any part; if so, where, and to what extent? Does the coast furnish any *fuci* or other plants that are or may be applied to useful purposes? if so, give an account of them, and of the uses to which they may be put. Is amber or ambergris found upon the shore? For the details of the fisheries, pearls, coral, sponge, &c., see *Fisheries*. Are there any springs of fresh water issuing up through the sea along the coast? if so, describe the place and accompanying phenomena.

In speaking of the coast of a country, we include the accidents which exist in the bed of the sea to a certain distance, such as shoals, rocks, coral-reefs, &c., which, according to circumstances, may be deemed a defence to the country or an impediment to navigation; they should, therefore, be noticed as to their nature, situation, and extent. Are they always uncovered or covered with water, and to what depth at ebb and flood, or are they alternately covered and uncovered by the tide, or during the prevalence of certain winds? Generally speaking, is the coast of easy or difficult access? Is it subject to violent storms or to dense fogs, and, if so, from what direction do the storms or the fogs come, and at what time of the year? Is there constantly a violent surf, or only at certain seasons, and with certain winds? What are the prevailing winds? What are the hours at which the sea and land-breezes blow, and to what distance inland and off shore are they felt? To what height do the ordinary, the spring, and neap tides rise, in different parts of the coast? What is the direction and strength of the currents* observed; what is their effect in eroding the coast, in clearing away, or in forming shoals? Is the sea in general observed to gain upon the land, or to recede from it; and, in either case, to what extent within a given time? If the sea along the coast freezes in winter, when does it

* Be it particularly observed, that, when speaking of the direction of the currents of the sea, we refer always to the point to which they tend, not the point from whence they come. Thus, a N.E. current is one that flows from the S.W. to the N.E. In the case of wind, it is just the contrary. A N.E. wind is one which blows from the N.E. to the S.W.

begin to freeze, how long does it remain frozen, to what distance from the land does the ice extend, and what thickness does it attain.

What are the gulfs, bays, roadsteads, havens, harbours, and ports along the coast ? specifying their particular situation, extent, depth, nature of the bottom, and whether the anchorage be good or otherwise, with the number and kind of vessels they can respectively contain. In which of the ports are vessels completely sheltered ; in which are they exposed, and to what winds ? What is the hour of high tide at the full in different ports, and what is the depth of water in the port itself at ordinary, spring, and neap tides ? Are the ports and harbours easily made, or, if not, what are the obstacles ? Can ships enter when the tide is out ? In a voyage of discovery, or in the case of a good harbour but little known, it will be necessary to give a chart, with soundings, and sailing directions ; but this forms a part of the mariner's particular science, into the details of which we cannot enter.

All kinds of piers, breakwaters, embankments, batteries, lights, signal stations, land marks, buoys, &c. &c., along the coast generally, or at the ports and harbours in particular, must be noticed, and everything regarding them carefully observed and described in detail, particularly if they have anything remarkable. Are these objects maintained at the expense of the Government, or of the shipping interest, native and foreign ? Are the artificial defences of the coast well planned and organized ? What are the facilities or difficulties of forcing a passage, or of attacking and demolishing the forts and batteries ? For the details regarding the commerce carried on in any of the ports, the shipping, &c., see COMMERCE.

The observations hitherto pointed out refer particularly to the sea as connected with the country whose shores it bathes, but there are a number of observations to be made on the sea itself which are of great interest to general physics.

An object which should never be neglected in making the observations we are about to mention is, to note down with precision the longitude and latitude of the spot where they are made, together with the precise date and hour of the day or night, as also the position of the sun and moon. The principal observations are the following :—the direction and strength of the currents ; (their regularity or irregularity can only be ascertained by the repeated observations of suc-

cessive travellers.) Endeavour to estimate the nature and the amount of the influence of the tides and winds in modifying the currents. The distance and places whence they come, or the currents which join them, may be sometimes inferred by the nature of the substances which are occasionally found floating in them. Are there any under-currents, and at what depth are they perceptible? In what direction, and at what rate do they run? Is the water still where a current is generally supposed to be always running, and if so, is there any reason for believing the current to be periodical, or merely occasional? Are there different, or contending currents in a limited space, if so, observe the direction of each, and its strength; does their meeting produce much ripple, or any whirlpools, and are these of a dangerous nature? What is the depth and nature of the bottom; the colour and transparency of the water; its temperature, saltness, and specific gravity at different depths? With regard to the colour of sea water, we are not aware, as yet, of any great practical utility to which observations on this subject may lead, though they may eventually be found important. A change of colour, however, from dark blue to green is generally indication of diminished depth or proximity to land. From the term *Sea-green* it may be supposed by many that this colour is peculiar to the waters of the ocean; and to those who have not quitted the shore, it may seem to be so; for, as we have just observed, the sea-green or aqua marine colour predominates near the land; but out at sea, the water is found to assume a variety of tints and colours, as various shades of blue from the deepest indigo to the lightest berlin or flax-flower-blue, greens, purples, and browns of different shades and intensity, and also whitish, or of a milky tint. To account for these varieties, and the tints assumed by large masses of water generally, whether fresh or salt, is not easy; it is a subject which has exercised the sagacity of philosophers, but no theory yet broached satisfactorily accounts for all the phenomena. The following is our own opinion, which we offer with deference.

Water is of itself without colour, and in those places where it is sufficiently shallow to admit of light being reflected from the bottom, shows only the colour of that bottom. At great depths, or where the bottom is black, no light can be reflected from it; the water therefore becomes itself a perfect reflector of the colour of the sky, to which it gives intensity upon the same principle as a blackened mirror. Be-

tween these two extremes there is a mean at which the colour reflected from the bottom blends with that reflected from the surface ; in which case, if the bottom be a yellow sand and the sky clear of clouds, the colour will be that known as sea-green, more inclining to yellowish or bluish green as the depth is less or greater. Thus blue and green I conceive to be the two colours natural to the sea : other tints must be accidental ; but to what they are owing is not easily determined. The particular colour of the bottom, when the water is shallow, must produce a modification of the tint : but where the water is deep, may not the tint depend upon microscopical particles held in suspension ? such as the detritus of moluscous animals, broken by the shock of the waves in a storm, or of marine plants pulverised by the same means, or some powder, of the nature of a pollen, given out in certain places, and at certain times by a subaqueous vegetation ? Such substances, invisible in a small quantity of water, may nevertheless communicate a sensible tint to a large mass. May not a large shoal of herrings, or other fish, sojourning for a while in certain parts of the sea, occasion an emission of air or gas, and may not this gas, by filling the water over it with innumerable minute bubbles, change the density and homogenity of the mass, and thus modify its refracting and reflecting properties, so as to communicate an uncommon tint to the water ? Or may not the fish be at such a depth as though not to be themselves visible, they may yet blend their reflected colours with the sky-tint at the surface. May not the slow action of subterraneous fire, by the emission of certain gases, produce some modification in the refracting power of the water ? In a word, many conjectures may be formed on this curious problem, and these and other hypothesis only require attention and well-directed observation in order to be finally admitted or rejected ; and whenever a perfectly satisfactory theory on the subject shall be established and confirmed, and the constancy of the phenomenon ascertained, then the colour of the water, in combination with other circumstances, such as its temperature, the season, &c., may become a useful indication.* As to the method of determining the colour of water, see OPERATIONS.

* It must be remembered that there are not wanting philosophers who consider water as in itself coloured. But if we admit this, it still remains to be explained why the water is differently coloured in different places, and why its colour is not constant in the same place.

In treating of rivers, we remarked that the transparency of large bodies of water is very different, though the water be to all appearances equally pure in the different cases. For the method of determining the transparency, see OPERATIONS.

With regard to the temperature of the sea, it has become an object of very considerable importance since the discovery that in the vicinity of, and immediately over shoals, the temperature is much lower than in the deep places; it is, therefore, extremely interesting to verify this fact by taking the temperature of the water wherever there is an opportunity of doing so. What is the effect of the waves in changing the temperature of the surface. The temperature must, if possible, be taken at various depths, and in all cases compared with that of the atmosphere. See OPERATIONS.

It has also been observed that the saltness of the sea is not exactly alike in different places, and that in some cases it is more bitter at the surface than lower down; precise observations on this subject are, therefore, very desirable. For the method of obtaining the degree of saltness, and also for bringing up water from any depth in order to examine it, see OPERATIONS.

The specific gravity of sea water, depending upon the quantity of saline ingredients, will also be different in different parts, besides which it is modified by the temperature. See OPERATIONS.

Observe the hygrometric state of the air over the sea, the indications of the thermometer and barometer, the magnetic variations, &c. See METEOROLOGY.

The luminous appearance, or phosphorescence of the sea, is a striking phenomenon, and well worthy the attention of the philosophic traveller. It is generally attributed to molluscous animals and zoophytes, the spawn of fish, and decaying animal and vegetable substances; most probably all these causes conspire to produce the effect, sometimes together and sometimes separately; it is, therefore, recommended to examine the phenomenon closely, both in itself and with reference to place, temperature of the water, and atmospheric temperature and pressure. Does the appearance precede or follow a storm; is it observed to have any reference to the electrical state of the atmosphere at the time or immediately before or after; what is the precise appearance, for this is often very different?

Besides the circumstances we have mentioned, there are

various others which he who is borne along upon the trackless deep will do well to notice; such as storms, calms, water-spouts, &c.; as also the molluscæ, the fish, and the birds that are met with in different parts. In a word, the traveller cannot be too often reminded, that the knowledge of a single well-authenticated fact, however insignificant in appearance, may serve to clear up some doubt, and, like the key-stone of an arch, consolidate reasonings otherwise well founded, but which, without this, would fall to the ground.

CONCLUSION.

When the traveller shall have obtained all possible information on the several subjects connected with the waters of a country, and shall have entered them neatly and distinctly in the way most convenient to himself in his note book, he will do well to put some of the principal data into a tabular form.

Such a table has the advantage of showing the extent of inland navigation, and the water-surface generally, both running and stagnant; an object of great interest when compared with the other grand divisions of the country into forests, cultivated lands, &c. Moreover the water-surface being known, this datum, combined with other circumstances, will serve to explain those meteorological phenomena of the country which depend upon evaporation, and to determine, in a great degree, the nature of its climate.

Few travellers, it is true, remain long enough in a country to be able to fill up such a table in all its details from their own observation, but the deficiencies may, in many cases, be filled up from authentic documents, and these should always be had recourse to if possible.

The other objects which may have been observed in examining the waters of a country, such as the commerce carried on by inland navigation, the fisheries, &c., must each be transported to its particular article in the traveller's notes; the traffic to the article COMMERCE, the fisheries to the ANIMAL PRODUCTIONS, or to INDUSTRY, and so of the rest.

SECTION III.

METEOROLOGY, AND THE CLIMATE OF A COUNTRY.

By the Climate of a country is understood the degree of heat and cold, humidity or dryness which prevails. Climates are very different; they are caused by the combined influence of latitude, relative position of sea and land, and height above the level of the ocean; and are also modified by the prevalence or absence of mountains, sterile sands, extensive lakes, marshes, forests, &c. The effect of climate on a country is to produce a greater or less fertility, and on its inhabitants to modify their physical energies and moral character. Hence climate is an object deserving the attentive consideration of the traveller, and the conclusion he arrives at regarding it, will result from a combination of all the observations he may have made of its various elements. Of the geographical and relative position, particular aspect and hydrography, we have already treated; we come now to speak of meteorology, or the phenomena of the atmosphere, whose habitual state in any country constitutes the climate of that country.

The various phenomena which take place in the atmosphere are termed meteors; they may be divided as follows:—

Aërial Meteors; or the winds, the dry fogs, and the exhalations which emanate from bodies on the earth's surface, and remain suspended in the lower strata of the atmosphere.

Aqueous Meteors; as clouds, fogs, rain, dew, hoar-frost, snow, and hail.

Igneous Meteors; or the *ignes fatui*, falling stars, bolides and aerolites, together with the Aurora Borealis, lightning, &c., the two last are, properly speaking, electrical phenomena.

Luminous Meteors; rainbows, haloes, parhelia, paraselenæ and zodiacal light.

But first, of the atmosphere itself.

Of the Atmosphere.—A learned French philosopher says, in speaking of the atmosphere, "Every one would like to foresee its vicissitudes and know their causes. The husbandman owes everything to the atmosphere; on it he

depends for his success or failure; he experiences its salutary influence, or dreads its cruel effects; his harvest is not the sole object which interests him; his health, in most cases, depends upon the state of the atmosphere. Prudent from habit and necessity, he commits no excesses, but the slightest alteration in the aërial fluid deranges the physical economy of his body. The air which he breathes may become a poison, and while in the fields he may be asking of the earth the recompense of his labours, the sustenance of himself and his family, he may, on his return home, bring with him the germ of long and acute disease. How important is it, then, that man should know the atmosphere."

The atmosphere, besides being essential to animal and vegetable life, is the grand laboratory in which are prepared and developed the various phenomena we have already enumerated. But we shall begin with speaking of the air itself.

The air is fluid, elastic, expansible, and heavy; on this last property is founded all the indications of the *Barometer* and the various uses of this instrument. The expansibility of the air is developed by means of caloric, whose effect is measured by the *Thermometer;* its elasticity and fluidity, set in motion by temperature and luni-solar attraction, are the cause of winds; for, like all other fluids, the air seeks its equilibrium, and in flowing, as it were, from a part where it is dense to one where it is rarefied, or which is momentarily deprived of it by some accidental cause, it produces those currents which we call wind. The air is composed of oxygen and nitrogen, or azote, in the proportion of 21 parts of the former to 79 parts of the latter in bulk, or 23,25 and 76,75 in weight; a trace of carbonic acid gas, about 0.001 according to Dalton, is also discoverable. Its pressure is about 2,160 lbs. on every square foot of the earth's surface. The height of the atmosphere, deduced from the duration of the twilight, is estimated at from 45 to 50 miles. The weight of a column of air of this height is equal to that of a column of water of equal base, and 35 feet high, or of a column of mercury $30\frac{1}{2}$ inches high. A man's body, taken at an average surface of 15 square feet, sustains a weight of air exceeding 32,000 lbs.

Besides the immediate elements of air, the atmosphere always contains a greater or less quantity of water in the state of vapour, and various gaseous exhalations.

The quantity of oxygen gas contained in the atmosphere

is found by means of the *Eudiometer*, and its degree of humidity is ascertained by the *Hygrometer*. The temperature varies not only with the latitudes of places, but according as they are more or less elevated above the surface of the sea. Thus an elevation of thirty fathoms causes the same variation of temperature as a removal of one degree from the equator towards the poles. At the height of 15,740 feet above the level of the sea, at the equator, we attain the region of perpetual snow, and arrive, as it were, at the 71st parallel of latitude. In the ascent from the plain we experience the influence of every variety of climate, and pass through every degree of vegetation.

The air is more or less mixed with exhalations according to the height, a circumstance which has great influence on health. According to the observation of De Saussure, it would appear that a height of 3,600 feet is not the most favourable situation for the human species. If, says he, the air of the plains is loaded with heavy exhalations, on the other hand, the air of regions elevated to 600 toises is vitiated by exhalations of another kind, which, though lighter than air, do nevertheless diminish its salubrity, so that the common air most favourable to health is that of the plains and great valleys of Switzerland, placed at about 1200 or 1800 feet (French measure).

The salubrity of the air in different places depends, in great measure, upon the state of the surface of the earth in these places; but, independent of the cause, the habitual state of the atmosphere in any place should be exactly observed by the scientific traveller, the more particularly as its influence is paramount on the animal and vegetable economy.

If I shall here dwell a little upon the effects of different states of the air, it is in order to guide the traveller in his determinations, whenever his object is the choice of spots for new settlements, which, after they are established, frequently prove unhealthy from want of a due consideration, *a priori*, of the habitual state of the air or weather.

An old writer, who has paid particular attention to the effects of the atmosphere on organized beings, says,—"The weight and elasticity of the atmosphere exercise a less immediate influence on the animal and vegetable economy than its temperature, its humidity or dryness, and its electricity. These four circumstances are the cause of all the changes, of all the states of health or sickness through which animated

beings pass in the course of their lives.* Their successive and too rapid change, are almost always followed by sickness of one kind or other." We will endeavour to trace, in a few words, the effects of the atmosphere in different states.

If there be not a proper equilibrium and just proportion in the weight of the column of air which presses upon us,—if its degree of humidity or siccity be not conformable to the constitution, the character and the habits of those who breathe it, there generally results effects more or less prejudicial, and these become still more so, if the variations are sudden and excessive. Able physicians and intelligent observers, who keep a register of meteorological observations as connected with medicine and vegetable physiology, have remarked the general re-appearance of the same diseases with the same constitution of the atmosphere. Their results, peculiar to the several countries where they have observed, may be generalized to a certain extent and be of practical utility.

An excess of lightness of the atmosphere, when long continued, is accompanied, or immediately followed, by sudden death; apoplexies are more common, and those who are subject to epilepsy have more frequent and more serious attacks. During an excess of atmospheric pressure malignant and putrid fevers are very prevalent. These same excesses have an equally powerful influence on vegetation. All philosophic travellers have observed that plants grow languid, and that their vegetation is singularly retarded by a diminution of atmospheric pressure.

For a striking demonstration of this truth, let any one ascend to the top of some very high mountain, he will readily perceive that, in proportion as he arrives near the summit, and the atmospheric pressure diminishes, vegetation becomes languid: at a certain height nothing is to be seen but trees of stunted growth, averted plants, meagre and creeping herbs; and, at the region of perpetual snow, all traces of vegetation cease. The want of heat and of atmospheric pressure, as also, perhaps, of the carbonic acid, &c. which is more likely to exist in the lower regions, are the causes of this state of things.

On the other hand, again, an atmosphere too heavy, or

* This assertion is, perhaps, somewhat exaggerated; for, although it be indubitably true, that the state of the atmosphere exercises a most potent influence on men and animals, yet we cannot, with truth, say that it is the sole cause of sickness.

rather, too great an atmospheric pressure, and too long continued, retards vegetation. This might be in part attributed to the dryness which usually accompanies a dense atmosphere, if Mr. Duhamel had not observed the same languid state of vegetation in aquatic plants, which have always abundance of moisture. Great heat produces increased motion and effervescence in the animal humours, and dilates them to such a degree that they can no longer be contained in their respective vessels, which they consequently distend, and thus occasion inflammatory disorders, often terminated by copious perspiration or hæmorrhage. It often happens that the evil fixes itself in some one of the intestines, where it causes a dangerous obstruction. If the heat continues, these accidents become more numerous and more fatal: headaches, weakness of the extremities, a general languor, loss of appetite, attacks of fever, and slight inflammation of the lungs, are the usual effects of such a temperature. Baths, cooling drinks, and a change in the state of the air cause them to disappear.

Heat appears, at first sight, favourable to vegetation. The greater the heat of summer, with a corresponding moisture, so much the sooner will be the harvest. A gentle heat rarefies the vegetable juices and increases their fluidity: it maintains in an equable state that internal heat of the plants which, when moderate, is one of the principles of vegetable life. But whenever the heat of the atmosphere is unaccompanied by moisture; whenever it has dried up the surface of the soil, so that it no longer emits a sufficient quantity of aqueous vapour; that is to say, whenever a burning heat succeeds to a gentle warmth, everything perishes; more is lost by perspiration than is supplied, and reproductive juices no longer circulate through the ducts of the exhausted plant. The sap and the juices dry up altogether, or, reduced to the smallest volume, ferment and become sour; the plant withers and dies.

Every extreme is hurtful; as much as cold in a slight degree and in the proper season is favourable to the health of animals and plants, so much is it dangerous when it is excessive, of long duration, or if it happens at a time when a gentle heat should reign in the atmosphere.

The coagulation of the lymph, inflammation of the lungs, catarrhs, long and fatiguing coughs, gripes, pains in the bowels, &c. afflict those who are exposed to such colds, or who are suddenly seized by them.

In the depth of winter, the cold of the atmosphere is not dangerous to vegetation, but nothing is so hurtful as the partial thaws and morning frosts of spring, when the buds are beginning to shoot or are already developed. At a more advanced period of the season, when the grain is in flower or the ears beginning to form, a frost destroys the hopes of the husbandman and kills his crop. Autumn frosts are also hurtful, but the mischief they do is generally repaired by the influence of spring.

The air, as we have already observed, has the property of holding aqueous vapour in suspension. When there is too great a quantity of this, and it is not dissipated by heat or wind, then the constitution of the atmosphere becomes fatal. There are very few chronic diseases which are not then increased. Acute and long continued rheumatic pains paralyze the limbs, catarrhal fevers prevail, and the scurvy, particularly in places bordering on the sea, commits great ravages whenever cold and moisture exist together.

Of all states of the atmosphere its moisture is unquestionably that which is most beneficial to vegetation, but again, nothing can be more prejudicial under certain circumstances. For instance, when a burning sun shines upon plants covered with moisture, every drop of water becomes a lens which, concentrating the rays into a focus, augments their intensity and burns the plant. Should frost surprise the plants, still wet with the moisture deposed by dew, fogs, or rain, other effects, but equally pernicious, are the result. If neither sun nor wind dissipate the too abundant moisture from the plant, it is exposed to the danger of becoming mouldy and rotten.

We have yet to speak of a particular agent which pervades the air as well as the earth, and which, though apparently in a quiescent state, is ever active, and sometimes produces the most tremendous effects; we allude to electricity.

The experiments of philosophers abundantly prove the almost constant existence of electricity in the atmosphere: and M. Bequerel and others have shown how the evaporation from the ocean, and the perpetual mutations going on at the surface of the earth, continually supply the atmosphere with electricity.

Storms and tempests, if not immediately produced by electricity, are ever accompanied by electrical changes, which, in the case of thunder and lightning, are audible and visible, and too frequently disastrous. The formation

of clouds, and their precipitation in rain, may be accounted for by electrical action; aqueous vapour, in whatever state, being the grand vehicle of the electric fluid which it transports and extends over the regions of the atmosphere. The presence of this fluid, when abundant in the air, is rendered sensible by electrometers and conductors; and many individuals are so organized as to be very sensible to the electrical changes of the atmosphere.

The electrical fluid being continually present in the atmosphere, cannot exist there without exercising a direct influence on all organized beings who inhale the air; and it is probably the great agent which induces or modifies those chemical changes that are ever going on in organic matter.

Thus we have endeavoured to show the important part which the atmosphere performs, and the necessity of observing its modifications, so as to be able to understand and describe the climate of a country, and to explain, in a satisfactory manner, many phenomena highly interesting to animal and vegetable physiology.

WINDS.—The winds, as we have already observed, are nothing more than the air in motion; they purify the atmosphere, distribute rain over the face of the earth, propel our vessels, and turn our mills; such are a few of their advantages; but when they are urged forward with too much violence, they become a destructive meteor, as is too well known to the inhabitants of the Chinese coast, of Japan, of the island of Bourbon, the Antilles, and other places subject to hurricanes; sometimes they bring us the pestilential miasmata of distant countries, or parching drought. There are four kinds of winds: 1st. Those that blow regularly and constantly in certain places, and which are denominated Trade-winds. 2nd. Regular periodical winds, such as the Monsoons. 3rd. The Sea and Land-breezes, which are also periodical; and, 4th. Variable winds.

It would be foreign to our object to enter into minute details regarding the cause of winds in general, or of the several kinds in particular; nevertheless, the traveller may be reminded that a change of temperature in any part of the atmosphere, or a diminution, or increase, of the quantity of aqueous vapour it contains, or any other circumstance which destroys its equilibrium, by occasioning a more or less rapid flow of air to re-establish that equilibrium, causes wind. Hence, it is evident, that any cause continually operating to change the density of any particular portion

of the atmosphere, must produce a constant wind, and this is precisely the case with the

Trade-winds.—The heat of the torrid zone, by rarefying the air of that region, causes it to rise, when the colder air of the temperate zones rushes towards the equator to supply its place; but as the colder currents of air come from regions where the rotatory motion of the earth's surface is much slower than it is at the equator, and as they cannot at once acquire the greater velocity peculiar to the equatorial region, their direction is relatively modified, and they become North East and South East winds. If the northern and southern hemispheres were equally heated, the equator itself would be the common limit of the two trade-winds; but, owing to the greater quantity of land in the northern hemisphere, it is warmer than the southern; and hence the limit between the two winds is about three or four degrees to the north of the equator. It must not, however, be imagined that the two winds actually meet; for on approaching the equator, they become gradually heated, and acquire an ascending direction, so that their horizontal motion is no longer felt, and there exists a band or belt, of a few degrees in breadth, where the air is usually calm, unless occasionally agitated by violent storms. The trade-winds extend generally about 30 or 40 degrees each way, but the limits vary in each hemisphere, as the sun's declination is north or south. It may be further remarked, that it is only over the wide ocean that the trade-winds can blow uninterruptedly; they are hardly perceived on land where their course is diverted by mountains, and their effects neutralized by a great variety of local influences. Indeed the very vicinity of large continents, as Africa and America, where the air is rarefied by reverberated heat, changes the course of the trade-winds along the coasts.

The Monsoons are regular periodical winds, almost peculiar to the Indian Ocean, where, from April to October a South West wind prevails north of the equator, while a South East wind blows during the same months from about the third to the tenth degree southward of the line. From October to April, a North East wind blows north of the equator, and a North West from the equator to the 10th degree south. These winds extend to the China Sea, and among the islands to the North West of Australia. They are very regular and strong in the Java Sea, and thence eastward towards New Guinea. In the China Sea their di-

rection is more North and South. In the Red Sea and Mozambique Channel they follow the direction of the coast. There is also a kind of monsoon which is felt along part of the coast of Brazil and in the Bay of Panama.

The Monsoons, it appears, are a modification of the trade-wind, occasioned by the interposition of the Asiatic continent to the North, the rarefied atmosphere of Africa on the West, the partial openings among the islands which separate the Indian Ocean from the Pacific, and the position of the sun in the different seasons. The South West monsoon is violent and accompanied by rain; the North East is gentle and dry. The breaking up of the monsoons, as their change is called, is accompanied by a dreadful commotion of the elements, and the storms and hurricanes which then prevail are sometimes most disastrous in their consequences.

Sea and Land Breezes.—We have said that whenever any cause is continual or periodical, its effect will be so likewise. Thus the periodical difference in the density of the air over the land, by the alternate presence and absence of the rarefying influence of the sun, causes those periodical winds, known by the name of Sea and Land Breezes; the hours at which they are felt differ somewhat in different countries and at different seasons; generally, the breeze from the sea begins to be felt a few hours after the sun has risen; and, after sun-set, the air of the land, condensed by the diminution of temperature, rushes towards the sea. It is on the coast of Malabar that these breezes are particularly developed; their influence is said to extend to a distance of twenty leagues from the land. In the Mediterranean they are also very perceptible. The same cause, viz., a local and periodical change in the density of the atmosphere, produces those regular inland breezes which are experienced, in some situations, in the morning and evening. They are due to the proximity and relative position of snow-covered mountains, extensive forests, marshes, or sandy deserts, the air over which is differently affected by their several reverberating and radiating properties.

Variable Winds are those which, as their name indicates, are altogether irregular as to time, direction, and force, and for which, it is difficult to account precisely, from our not being sufficiently acquainted with the position and relative influence of the various circumstances which, acting together or in opposition to each other, produce these partial and ever-fluctuating aërial currents; nevertheless, were it not for the continual mutation which takes place on the

surface of the earth, from natural causes, and from the labour of man, the winds might perhaps, to a certain degree, be explained and predicted; but this, probably, will never be satisfactorily accomplished: to know the winds, would be to predict the weather.

From what has been said, it is easy to deduce the nature of the observations to be made by the traveller on the winds. The two first kinds, it may be remarked, and the extent seaward of the land breezes, can be observed only by the traveller on the high seas, while the land and sea breezes may be observed, as to time and extent of influence inland, by those who remain on shore. The periodical inland breezes and variable winds may be observed by all travellers.

With regard to the trade-winds and monsoons, they are so well known as, perhaps, to require but little notice; nevertheless, those in a situation to observe them will do well to note the longitude and latitude of their position at the time of making their several observations; the date and time of day; the positions of the sun and moon; the exact direction and force of the wind as nearly as possible, with the indications of the thermometer, barometer, and hygrometer; the temperature of the sea, and all the meteorological phenomena by which the winds are accompanied. For although these winds, generally speaking, blow with much regularity, many changes going on at the earth's surface may induce modifications that remain unnoticed, till exact observation proves their existence; and any new fact regarding them will be highly interesting.

Of other winds, in general, the traveller should note the absolute position of the place, and its relative position as regards large surfaces of land or the sea, large lakes or extensive marshes, forests, mountain ranges, sandy deserts, and other circumstances likely to induce local derangement in the equilibrium of the air. The date of the observation must be noted, and the position of the sun and moon; the temperature, pressure, and hygrometric state of the air; the direction and rapidity of the aërial currents, and any particular meteorological phenomena by which the wind may be preceded, accompanied, or followed; to which, if the wind be a sea and land breeze, may be added, observations on the modifications induced by the tides on these winds, or by these winds on the tides and currents of the coasts.

The grand object of all such observations being to arrive

as nearly as possible at a knowledge of the laws of nature; the traveller must not confine himself to observations alone, but should endeavour to explain, to the best of his ability, the causes of any anomalies he may observe, or of any regular influences he may discover, particularly if they occasion any interruption of regularity in the periodical winds, or tend to regularize those which are variable.

As for those furious winds known by the names of Storms, Hurricanes, Harmatans, Tornadoes, &c., the traveller must note the time, and the direction whence they come, and the phenomena which accompany them, the extent of their sphere of activity, and their effects, always more or less disastrous.

Of late years it has been ascertained, almost beyond a doubt, that storms have a rotatory motion; that they are, in fact, whirlwinds on an immense scale, having, like the smaller ones we often observe, a movement of translation from one place to another, and a movement round their own axis. We recommend the reader to consult, on this subject, the highly interesting and instructive work of Col. Reid on Storms.

Some winds are known to possess particular qualities, such as the hot winds felt on the northern coast of Africa, in Persia, India, and China; the cold winds of Siberia, the pestilential Samoom or Samiel of Africa, Arabia, and Mesopotamia, &c.

Whirlwinds are very common in certain countries, at certain seasons; at sea and on large lakes they cause water-spouts; on land they raise into the air substances of greater or less bulk and weight, according to their violence. In the plains around Agra, in the East Indies, as many as thirty whirlwinds may be counted at a time, sweeping over the country, and urging along vast columns of sand of many feet in diameter, which, whirling upwards as they proceed, attain to a great height in the atmosphere. This phenomenon is sometimes followed by hail, and the hail-stones are then found to contain so great a quantity of sand, that a half-pint glass filled with them, upon being thawed, leaves a deposit of half an inch in thickness. But some whirlwinds occasion the most dreadful devastations, of which many records exist.

Particular attention must be paid to those winds which bring rain or snow, frost or thaw.

It has been remarked that, in the southern countries of Europe, whenever the south wind blows it is accompanied by rain, or by storms, and excessive heat. Breathing is then incommoded, the vessels are distended, and perspiration is abundant. If this wind reigns for any length of time it induces a general relaxation, and the head becomes affected with giddiness. This wind, which is called the Sirocco, often brings the seeds of epidemic and contagious diseases; meat is so affected by it as to become putrid almost immediately.

Trees which have a southern aspect, or which grow in southern countries, have a thinner and finer bark than trees otherwise situated; and, in colder regions, the side of the tree exposed to the south, is observed to be more abundant in sap than the northern side.

A south wind, when not too dry, is generally the most favourable for agriculture, particularly when trees are to be planted or seeds sown. These observations regarding the difference between the north and south sides of trees, and the wind most favourable to agriculture, refer particularly to our hemisphere, and perhaps to particular countries. The fact is, that relative difference in vegetation *cæt. par.* depends, in great measure, on the direction and the nature of the prevailing local winds; and when their particular effects are known, these effects may in many cases serve, in the absence of other indications, to point out the prevailing winds of a country. Generally speaking, winds which blow from the sea, from extensive lakes or marshes, are moist, cold in summer and warm in winter. Continental winds are generally dry, warm in summer and cold in winter. In a word, winds derive their quality from the regions whence they come originally, or from the modifications they experience in the countries over which they pass; and as it is the nature of the most prevalent winds which particularly modify, if they do not altogether regulate, the climate of a country, this will frequently be found to be very different from what might be expected from its latitude and longitude; so that, in the description of a country, the traveller should neglect nothing which relates to the winds.

The points most important to remark respecting the wind are, according to Sir J. Herschell, as follow:—

1. Its average intensity and general direction during the several portions of the day, devoted to observation and registry.

2. The hours of the day or night when it commences to blow from a calm, or subsides into one, from a breeze.

3. The hours at which any remarkable changes of its direction take place.

4. The course which it takes in veering, and the quarter in which it ultimately settles.

5. The usual course of periodical winds, or such as remarkably prevail during certain seasons, with the law of their diurnal progress both as to direction and intensity; at what hours, and by what degrees they commence, attain their maximum, and subside, and through what points of the compass they run in so doing.

6. The existence of Crossing Currents at different heights in the atmosphere, as indicated by the course of the clouds in different strata. In observing these it is desirable to fix the eye by some immoveable object, as some point of a tree or building, the sun or the moon; otherwise mistakes are apt to arise.

7. The times of setting in of remarkably hot or cold winds; the quarter from which they come, and their courses as connected with the progressive changes in their temperature.

8. The connexion of cloudy or fair weather, with the quarter from which the wind blows or has blown, for some time previous.

9. The usual character of the winds as to moisture or dryness, not as deduced from mere opinion or vague estimation, but from actual observation of the hygrometric state of the atmosphere during their prevalence.

As to the strength of the winds various instruments have been devised for estimating it. See *Anemometer*, section Instruments.

It may be well to add that, in some situations, the planting of forests may screen a position from hurtful winds, while the clearing of forests may prove the ruin of whole provinces, by giving passage to such, by drying up springs, &c. As a guide to the determinations of the traveller we insert the following table from the philosophic transactions:—

Velocity of the wind. Miles in an hour.	Perpendicular force on one square foot in avoirdupoise lbs. and dec. parts.	Common appellation of the force of such winds.
1	,005	Hardly perceptible.
4	,079	Gentle pleasant wind.
5	,123	

10	,492	Brisk Gale.
15	1,107	
30	4,429	High wind.
35	6,027	
50	13,300	A storm.
80	31,490	A hurricane.
100	49,200	

DRY FOGS AND EXHALATIONS.—Dry fogs differ from exhalations by their being visible, which the latter are not; they are not common, and only occur during great droughts: they are supposed to be in some way connected with volcanic irruptions, from their having been noticed all over Europe at the time of the great Islandic irruption, and immediately after the disaster in Calabria; and, in the Tyrol and Switzerland, in 1755, immediately before the earthquake of Lisbon. The fog, in these cases, was found to be occasioned by a very fine dust floating in the air. But dry fogs are not always of this kind, though it is hard to say precisely what they are. As for Exhalations, they are of many kinds, and present phenomena more or less remarkable, more or less injurious, according to their nature. In some countries, and these not always volcanic, they are continually rising; they are, nevertheless, regarded as a remarkable phenomenon, and when they are met with, they should be described in detail; note being taken of all the circumstances which precede, accompany, or follow their appearance; and the causes, if they can be ascertained, which produce them.

AQUEOUS METEORS.—*Fogs* are more or less dense masses of aqueous vapour, which rest immediately on the surface of the earth, or cling to the sides of mountains; when suspended high in the air, they are called clouds.

Aqueous vapour is produced chiefly by the solar action on the surface of the sea, of rivers, of lakes, and wet places, and is therefore formed in greater abundance in summer than in winter—in the middle of the day than in the morning or evening; nevertheless, fogs are more common in the autumn than in any other season, and are more frequent in the morning and evening than in the middle of the day. The reason of this seeming contradiction is this: when the atmosphere is very hot, the aqueous vapour is dissolved in it as fast as it is formed, and is not visible until it reaches the higher and colder regions of the atmosphere, where it is condensed

into clouds; but in the autumn, when the changes from heat to cold are most sudden, the vapour of the atmosphere, quickly condensed, becomes visible. The fogs of the morning are the vapours precipitated during the night; while those of the evening, are occasioned by the sudden cooling at sun-set of an atmosphere loaded with vapour by the heat of the day. Fogs are generally dissipated by wind; but wind sometimes engenders them, by mixing a current of warm and moist air with one that is colder. It is in the hottest and serenest days in summer that the atmosphere contains the greatest quantity of moisture, and, though not visible, its ascent may be observed by looking along the surface of the ground, at objects placed at a little distance, when these objects will be found to have a tremulous motion, produced by the intervening ascending vapours.

The traveller must observe the nature and prevalence of the fogs wherever he may be; the time of the year, and whether the fogs are most common in the morning or the evening; at what time relatively to the setting of the sun, the evening fogs appear; and how long after sunrise those of the morning remain before they are dispersed. Sometimes they ascend in a body and remain floating in the higher air as clouds. Are the fogs of that kind which you may pass through and remain dry, or of the nature of what is termed a "Scotch mist," which wets you to the skin? The temperature in the fog should also be noted, and the winds which prevail in the season of fogs, or which bring those that are only occasional.

The dark colour of our London fogs is probably owing to the great admixture of smoke with the aqueous vapour.

Clouds, as we have just said, are masses of condensed vapour suspended in the atmosphere; they are of great importance to the earth, whether considered as the reservoirs of the rain which fertilizes the earth, or of the snows which clothe and keep it warm in winter, or regarded as screens against the continued ardour of the sun. They are also the grand vehicles of the electric fluid.

The formation and dispersion of the clouds is a very regular phenomenon in certain countries at certain seasons; but, generally, they are as irregular in their appearance as the winds. Their height varies with the seasons: in summer they are much higher than in winter, though they are seldom very high at any time. Certain clouds, in certain positions,

are often the never-failing precursors of wind, rain, or storms; such should be particularly noticed by the traveller. The forms of clouds are very various, and would seem, at first sight, to be both difficult to classify, and of no importance if classified; they have been, notwithstanding, arranged in order; and as the different kinds bear an intimate relation to the state of the atmosphere, they are well deserving of attention, and are now generally indicated in all journals of the weather. The following is the arrangement of the clouds according to Luke Howard, Esq.:—

Simple modifications.	1 Cirrus. 2 Cumulus. 3 Stratus.
Intermediate modifications.	4 Cirro-cumulus. 5 Cirro-stratus.
Compound modifications.	6 Cumulo-stratus. 7 Cumulo cirro-stratus or nimbus. 8 The fall cloud.*

The *Cirrus* is parallel, flexuous, or diverging fibres, extensible in any or in all directions.

The *Cumulus* is convex or conical heaps, increasing upwards from a horizontal face.

The *Stratus* is widely extended, continuous horizontal sheets, increasing from below.

The *Cirro-cumulus* is small, well-defined, rounded masses, in close horizontal arrangement.

The *Cirro-stratus* is horizontal, or slightly inclined masses, attenuated towards a part or the whole of their circumference, bent downward or undulated, separate,

* It has been proposed still further to extend this division of the clouds, by using the augmentative termination onus, or the diminutive itus. Thus:—Cirronus; Cirritus; Cirrono-stratus; Cirrito-stratus; Cirrono-cumulus, Cirrito-cumulus; Stratonus, Stratitus; Cumulonus, Cumulitus; Cumulono-stratus, Cumulito-stratus. Should these be found insufficient to convey distinct ideas of every variety of clouds, the second word may be augmented or diminished, thus:—Cirrono-stratitus, &c.

The terms may be abbreviated for common use by writing only the first letters of each word; allowing one letter to represent the diminutive, two letters the ordinary or middle degree, and three letters the augmentative. As Cirrus and Cumulus begin with the same letter, it will be necessary to make a distinction between them by taking two, three, or four letters, respectively, of Cumulus, thus:—C., Ci., Cir.; S., St., Str.; N., Ni., Nim.; Cu., Cum., Cumu. Suppose it were desired to express Cumulito-stratoni, C. Str. would be sufficient, &c.

See Appendix to 2d vol. of a "Narrative of the Surveying Voyages of H. M. ships Adventure and Beagle."

or in groups consisting of small clouds having these characters.

The *Cumulo-stratus*, or *twin-cloud*, is the cirro-stratus blended with the cumulus, and either appearing intermixed with the heaps of the latter, or superadding a wide-spread structure to its base.

The *Cumulo-cirro-stratus*, or *nimbus*, or rain-cloud, is a cloud or system of clouds from which rain is falling. It is a horizontal sheet, above which the cirrus spreads, while the cumulus enters it laterally and from beneath. The *Fall-cloud* rests apparently upon the surface of the earth.

The Cirrus appears to have the least density, the greatest elevation, the greatest variety of extent and direction, and is seen earliest in serene weather, being indicated by a few threads pencilled on the sky. Before storms, they appear lower and denser, and usually in the quarter opposite to that from which the storm arises. Steady high winds are also preceded and attended by cirrus streaks, running quite across the sky in the direction in which the winds blow.

The Cumulus or heap-cloud has the densest structure, is formed in the lower atmosphere, and moves along with the current next the earth. A small irregular spot first appears, and is, as it were, the nucleus on which the vapours accumulate; the lower surface continues irregularly plane, while the upper rises into conical or hemispherical heaps, which may afterwards continue long nearly of the same bulk, or rapidly rise into mountain forms. They will begin, in fair weather, to form some hours after sunrise, arrive at their maximum in the hottest part of the afternoon, then go on diminishing, and totally disappear about sunset. Previously to rain the cumulus increases rapidly, appears lower in the atmosphere, and with its surface full of loose fleeces and protuberances. The formation of large *cumuli* to leeward, in a strong wind, indicates the approach of a calm with rain. When they do not disappear or subside about sunset, but continue to rise, thunder is to be expected in the night.

The Stratus has a mean degree of density, and is the lowest of clouds, its inferior surface commonly resting on the earth, in water; this is properly the cloud of night, appearing about sunset. It comprehends all those creeping mists which, in calm weather, ascend in spreading sheets (like an inundation) from the bottom of the valleys and the

surface of lakes and rivers. On the return of the sun, the level surface of this cloud begins to put on the appearance of the Cumulus, the whole, at the same time, separating from the ground; the continuity is next destroyed, and the cloud ascends and evaporates, or passes off with the appearance of the nascent Cumulus. This has long been experienced as a prognostic of fair weather.

The Cirrus having continued for some time increasing or stationary, usually passes either to the Cirro-cumulus or to the Cirro-stratus, at the same time descending to a lower station in the atmosphere. This modification forms a very beautiful sky, and is frequently, in summer, an attendant on warm and dry weather. The Cirro-stratus, when seen in the distance, frequently gives the idea of shoals of fish; it precedes wind and rain, is seen in the intervals of storms, and sometimes alternates with the cirro-cumulus in the same cloud, when the different evolutions form a curious spectacle. A judgment may be formed of the weather likely to ensue, by observing which modification prevails at last. The solar and lunar haloes, as well as the parhelion and paraselene (mock sun and mock moon) prognostics of foul weather, are occasioned by this cloud. The Cumulo-stratus precedes, and the Nimbus accompanies rain. On the subject of Clouds the traveller will notice of what kind they are, at the hours that he makes his other meteorological observations, which should be at least three times a-day, as we shall presently point out. Independent of which, he will do well to observe the parts of the horizon whence they generally seem to rise, or the part of the atmosphere where they begin to appear; the direction of the tails of the cirri and the crossing of their slender threads; the direction and parallelism of the cirro-strati, &c.; the phenomena of the change of form of the clouds; their accumulation and dispersion; and the rain, snow, hail, thunder, or wind which they bring. Their general prevalence, like that of fogs, &c., can, of course, be gleaned only from a long series of observations made during a residence.

Sir J. Herschell justly observed that, "with regard to the forms and outlines of clouds, they can be correctly ascertained for those clouds only which are directly vertical, the others being more and more foreshortened by perspective as they approach the horizon; their magnitude is also diminished by distance, and their intervals covered in and hidden by their mutual interposition."

The height of the inferior surface of the clouds should also be ascertained as nearly as possible.

Rain.—Common as are the aqueous phenomena of the atmosphere, philosophers are by no means agreed in their theories respecting them: rain has, therefore, been explained in different ways, and it is probably occasioned by several causes. Be this as it may, or whether rain be produced solely by the electrical action of clouds upon each other,—by an electrical spark communicated to a mixture of hydrogen and oxygen gases, by the mechanical condensation of the aqueous vapours of the atmosphere, affected by wind or by sudden cold, or, finally, by the contact of two saturated currents of air of different temperatures,—rain is, in fact, water, which, originally taken up into the air in the state of vapour, falls in liquid drops. The most important is to know its quantity, its nature and effects,—the signs which announce, and the phenomena which accompany, or which follow it.

Rain-water, though distilled by a natural process, is not absolutely pure; for, whether in its descent or in its rise as vapour, it contracts impurities from the substances ever floating about in the atmosphere, and becomes partially impregnated with the mephitic and other gases which it meets in its passage; hence it follows, of necessity, that rain-water has different qualities, according to the places whence it was first sublimed, and the circumstances of the atmosphere through which it falls, which are different in different places, and at different seasons. Thus the rain which falls in winter is much more pure than what falls in the other seasons; for in the winter few or no exhalations rise from the surface of the soil, in consequence of the want of heat and absence of those putrefactions and decompositions it engenders. The rains of summer, on the contrary, passing as they fall through an atmosphere loaded with exhalations, dissolve a part of these, particularly the carbonic acid, which they restore to the earth. These summer rains are very beneficial, for they purify the air and stimulate vegetation. The rains of spring and autumn participate, more or less, of the nature of those of summer and winter.

Rain acts, then, always as a dissolvent and a vehicle, and as it derives the elements necessary to vegetation from the air, which is itself modified by the seasons and by the circumstances of the soil, the difference in these must produce correspondent differences in the quality, as well as the

quantity, of the vapours which ascend, and of the rain that falls.

Rain does not always fall in the country which produced it; as we know there are countries which, producing of themselves little aqueous vapour, owe the rains that fecundate them to propitious winds which bring them the clouds sublimed in other regions. The nature of these rains must therefore vary with the winds, and indeed this has been proved by experiment.

The vapours raised from the surface of the Pacific, and driven by the sea-breeze against the western slope of the Andes, must produce rains very different in quality from those which water the great basin of Marañon; and in like manner the monsoons of India rain down upon the Malabar coast a much purer water than that which fertilizes the country to the eastward of the ghauts. The traveller who shall examine this subject will perhaps obtain results highly interesting, and which may throw a new light upon the facts connected with the geography of plants.

The temperature of rain-water varies very sensibly, which is due to the height from which it falls and the temperature of the air, which latter it, in turn, modifies; and as the warmth or cold of rain has a very important effect on vegetation, the temperature of the rain should be carefully observed.

Independent of the particular quality of the rain, as being more or less saturated with particles of a salutary or injurious nature, and of its temperature, it deserves attention on the score of its abundance or its scarcity. Too much rain is always prejudicial: thus the Andaman islands are so subject to rain, that, according to Captain Stokoe, who resided there a long time, there falls, in the course of seven months, ninety inches of water. These torrents of rain are brought by the S. W. monsoon, and being sublimed from the ocean, are wanting in those substances which are necessary to vegetation; a circumstance which, joined to their injurious abundance, may perhaps account for the remarkable sterility of these islands. At Borneo it is said to rain eleven months of the year. On the other hand there are countries, such as southern Persia, where rain is almost unknown; nevertheless the fertility of this country is great in consequence of abundant dews.

It may, however, be remarked, that the disadvantages of too much rain are greatly modified by the nature of the soil

on which it falls. On low and clayey lands the water remains, drowns the roots of plants, which rot in it, and gives rise to unwholesome exhalations, producing among the inhabitants of the countries, so circumstanced, fevers and other various illnesses. On an elevated, light, and sandy soil, abundant rain is not attended with the same evil consequences ; for it runs off, or filters through the ground, and can do no other harm than by laying bare the roots of such plants as grow on highly-inclined surfaces ; a disadvantage compensated by a general fertility which such soils, but for abundant rains, would not enjoy.

The way in which the rain falls is by no means indifferent ; heavy rains act mechanically, and do great mischief in certain seasons. If they happen at the moment of the opening of the anthers of the flowers, they wash off the pollen, and thus effect the abortion of the plant ; after fecundation, they knock off the flowers, and the harvest is lost ; if they happen at the time of the maturity of the ears, they lay the crops, and beat out the grain : whereas, the mechanical action of gentle rain is beneficial, it washes the leaves, opens the pores, and thus facilitates the important functions of respiration.

Without humidity, nothing can live or vegetate ; and if countries deprived of rain are not supplied with moisture by copious dews, or irrigated artificially, or by the inundation of rivers, they remain barren and uninhabitable.

One of the great benefits of rain is the supply of those inexhaustible springs, without which there could be no rivers. When rains are heavy, they sometimes cause the rivers to overflow their banks, which, in certain cases, is a great benefit, in others, a cruel disaster ; but whenever they cause a sudden and extraordinary swell of torrent-rivers, which are the only kind in some countries, they always produce consequences more or less disastrous : Italy is a striking example of this. From the small breadth of this country, and the nature of its conformation, descending in rapid slopes on either side the Apenines, the rivers are all torrents, and the inhabitants are exposed to their frequently repeated ravages. There is one very remarkable phenomenon of rain which is particularly worthy of attention, and for the existence of which we have the authority of Humboldt and of Captain Beechy ; it is the fall of rain from a perfectly azure and cloudless sky.

From this account of rain, the intelligent traveller will

easily understand the nature of the observations he is to make on this meteor. The season, quantity, quality, and manner of falling of the rain, the winds which bring it, and its disastrous or beneficial effects, all deserve his attention. The quantity which falls daily will be measured by the *Pluviometer*, see INSTRUMENTS.

Dew.—The formation of dew, like that of rain, has been explained in different ways. The prevalent opinion now is, that dew is a precipitation of the moisture of the atmosphere upon bodies at the surface of the earth, cooled below the temperature of the air by radiation ; so that clouds, or any other obstacle, which prevents the radiation of heat into space, impedes the formation of dew. Such is the result of the observations and experiments of Dr. Wells.

Dew is ever most abundant in the clear serene nights of warm weather, the deposition usually begins a little after sun-set and continues till a little after sun-rise. In windy nights, there is none, nor when the sky is covered by clouds ; though the presence of a few clouds is said to be more favourable to the formation of dew than a sky entirely uncovered. It is more abundant after rain than after long continued drought, and as the dew is in proportion to the abundance of moisture in the air, winds which blow from over the sea are more frequently followed by precipitations of dew than those which have passed over the land. In proportion as the ground becomes cooler throughout the night, the deposition of dew becomes more abundant.

It is generally considered injurious to health to remain exposed to the dew : to sleep in the open air when the dew is falling is particularly dangerous, and it is asserted, that, in certain parts of France, the dew is very hurtful to the cattle that are allowed to graze before it is entirely dissipated.

It has been generally believed that dew is most abundant in the neighbourhood of rivers, but it would appear from the accounts of Captains Clarke and Lewis that this is not always the case : they found dew to be extremely rare on the borders of the Missouri ; during their whole journey across the plains, watered by this river, dew was observed by them only twice, and the second time, on the 18th of May, the appearance of the dew was followed six days after by so hard a frost, that the water in their vessels was frozen to a thickness of a quarter of an inch during the night ; the edges of

the river were frozen, and the cotton plants stript of all their leaves.

The frequency or scarcity of dew is well worthy of the traveller's observation. He should notice all the circumstances of its formation, and everything which may tend to confirm or contradict the now-received theory, as also the beneficial or prejudicial effect of the dew upon the fertility of the country and health of the inhabitants.

Hoar-frost is frozen dew, and is generally observed in the cold autumn mornings, when the ground, the stones, and the trees, are covered with it. That on the ground and on stones is generally soon dissipated ; that on the trees remains sometimes throughout the day. In northern countries there is a phenomenon, similar in its nature, which takes place in the course of the day when the branches of trees become so loaded with the congealed vapour that the branches break with the weight. The beautiful foliated appearance on the windows of our dwellings, is an analogous phenomenon : in all these cases, it is a precipitation and congelation of aqueous vapour, and, in the north, the phenomena are of surprising beauty from the size and graceful or singular forms assumed by the dendritic concretions. The accumulations, like iron-filings presented to the magnet, group themselves in preference at the angles and edges of solid bodies.

Hoar-frost is hurtful to vegetation by loading the young branches with an unaccustomed weight, and by congealing whatever moisture may have penetrated the epidermis, or even the bark, and thereby bursting the minute cells in which it was lodged.

The reason and prevalence of hoar-frost, its appearances and effects, must not be passed over by the observant traveller.

Snow, as every one knows, is rain congealed before it falls to the earth. In snow, the atmospheric water is not only congealed, but it is crystallized, either perfectly or confusedly. Sometimes the crystals are solitary, spicular, lamellar, or pyramidal, and sometimes they are aggregated into stellar forms of more or less complex designs, but always partaking of an hexagonal arrangement. The larger flakes of snow, those which fall in the milder weather, are confused aggregations of smaller flakes. Scoresby has observed nearly a hundred regular forms of snow, some very remark-

able, and others extremely beautiful. Regularly crystallized flakes can only be formed in a very cold and calm atmosphere. It does not, however, appear that particular forms have any relation to particular temperatures; if we except perhaps the solitary spicular crystals which are seldom seen but in intensely cold weather. Snow is a meteor of great importance: accumulated on the heights, it affords, by its gradual thawing, a regular supply to rivers and to the interior reservoirs of the earth; in hot countries the snow-clad mountains temper the heat, and in cold climates snow secures vegetation from being killed by the frost. In very cold regions the snow never thaws: these regions are high at the equator, and descend as we approach the poles. See MOUNTAINS.

Some authors, Sir H. Davy among others, affirm that snow-water is very pure; others attribute the goitres and other complaints endemic in Switzerland to the bad quality of snow-water; both opinions we conceive to be exaggerated; goitres are common in Bengal where assuredly the people do not drink snow-water. One fact is certain, namely, that snow-water contains much more oxygen than other waters, and rusts iron much more speedily.

The observations to be made upon snow, are—the season when it falls; the quantity that falls, (ascertained by thawing and measuring); the frequency of the snow showers; the general size and nature of the flakes, and, if regularly crystallized, the forms should be delineated. Is the snow generally thawed as soon as it falls, or does it remain upon the ground? in the latter case, to what medium height is it accumulated when most abundant? What are the winds which bring it? Is it turned by the inhabitants into a particular advantage? as for sledging, &c., as practised by most northern nations, who transport their commodities with great facility over the snow. Is the reverberated light from the snow found to affect the sight of the inhabitants? Snow is sometimes found coloured in patches, the colours being red, or orange, or salmon-coloured. The extent of these appearances should be noticed, and the coloured snow examined, in order to discover whether the colouring matter be of an animal or vegetable nature.

Hail is a phenomenon on which the sagacity of philosophers has been much occupied, and the hypothesis they have imagined to explain it very considerably. The general opinion, however, seems to be, that hail is the result of ex-

cessive cold in the atmosphere, produced by sudden changes in the electrical state of the clouds; but, be the cause what it may, the effects are generally more or less disastrous.

The traveller will notice everything relating to such hail-storms as he may witness, and will obtain what information he can regarding their prevalence or rarity; the season, and the particular circumstances under which they happen, and the effects they produce. The form, size and weight of the hail-stones are worthy of notice, and they should be broken in order to observe their internal arrangement which is sometimes in concentric layers: they should also be thawed in a glass in order to observe any solid particles, as sand or volcanic dust, which they may contain.

In some European countries, conductors are set up to draw off gradually the electricity, to which the hail-stones are supposed to be due; in such case ascertain if they have been found to produce any beneficial effect.

OBSERVATION ON AQUEOUS METEORS IN GENERAL.—The aqueous meteors we have just noticed derive their origin from the earth. The heat of the sun and of the earth produces the vaporization of a part of the surface waters of the latter, though in truth water emits vapour even at a temperature below the freezing point, as has been satisfactorily proved by Dalton.

Evaporation proceeds with increased rapidity in a vacuum: whence it is evident that what has been called the dissolving property of the air, is nothing more than its faculty of holding in suspension the aqueous particles already vaporized.

Heat, whether radiating from the sun directly, or proceeding from its reflected rays, dilates the atmosphere and diminishes its pressure on the surface of the water, thereby facilitating evaporation; while the air itself acquires a greater capacity of containing aqueous vapour. If to this we add, that the power of emitting vapour is increased by an increase of temperature, we shall have the complete explanation of the fact that there is a greater quantity of aqueous vapour in the atmosphere in summer than in winter, in hot than in cold climates, and in the day time than at night.

Particular and local circumstances, by modifying the ascent of vapour and its state when in the air, occasions the various phenomena we have mentioned; and it is only by an exact and regular observation of the pressure of the atmosphere, the degree of heat and cold, the direction, the

force and duration of the winds, &c., that they can be separately understood, their reciprocal action explained, and the whole grouped together into a perfect system.

The utility of such a system, which shall embrace and explain all the phenomena, would be very great ; as we should then be enabled to predict, with much greater certainty than has ever yet been done, the periods and the duration of fogs, rain, fair weather, &c.—an object of the greatest importance to agriculture, and otherwise of general utility. The materials for such a system are far from complete, and as they must be gleaned from the whole face of the earth, the necessity of attending to all the phenomena of aqueous meteors must be evident to the traveller, when he would convey precise notions of the climate of a particular country, or furnish data to the science of Meteorology in general.

IGNEOUS METEORS.—*The Ignis-fatuus, St. Elmo's Fire*, &c.—The former of these is a meteor so well known as hardly to require being noticed here, but in order that our article on Igneous Meteors may be complete, we shall say a word on those curious appearances so long, and still, unfortunately, the terror of the ignorant. This meteor is by some explained to depend on two principal causes, 1st, a disengagement of carburetted hydrogen gas, and 2d, its inflammation by electricity ; but this idea seems erroneous.

The decomposition of organic bodies, animal and vegetable, it is true, disengages a quantity of inflammable gas, and this is the reason why this meteor is found most frequently hovering over burial places, swamps, &c. ; and, as heat facilitates putrefaction, the *ignes fatui* are more frequently seen in summer than in winter : but as the phenomenon is often observed when the atmosphere is by no means overcharged with electricity, it seems probable that the disengaged gas is phosphuretted hydrogen, which is known to inflame spontaneously on coming in contact with the air. The *ignis fatuus* deserves no particular notice, unless in any spot it be remarkably frequent, or present any thing very extraordinary. Some very remarkable *ignes fatui* have been described by different writers and travellers.

Those coruscations or little flames sometimes observed on the tops of steeples, on horses' manes, at the tips of umbrellas, on the points of soldiers' arms, at the masts and yards of ships, known among us by the name of St. Elmo's

fire, and called by the Spanish *Cuerpo Santo*, and by corruption *Corpusance*, are presumed to be purely electrical.

The appearance of St. Elmo's fire is generally regarded at sea as a precursor of storms, and as the phenomenon is always curious, it is deserving of being described whenever it is seen.

Falling Stars have shared the fate of other meteors, not only in being regarded as ominous, but in having been attributed to a variety of causes, all wide of the truth; nor are we yet quite satisfied as to the nature and cause of the phenomenon. All that we positively know is, that the regular recurrence of showers of falling stars about the 12th or 13th of November for several years, serves plainly to indicate that their appearance is not accidental. It is presumed that these shooting stars compose a *nebula* revolving round the sun, and that the earth in its path through its orbit passes through this *nebula*, or so near it as to attract the bodies which compose it, and which, by their nature and the rapidity of their motion, (about 14 miles in a second), became first inflamed upon entering our atmosphere, and are then dispersed in it. In their direction they all converge to a particular point in the heavens, whence they fall in parallel lines towards the earth. Independent, however, of these periodical showers, shooting stars may frequently be observed; and the traveller, in his peregrinations, should not fail to note the phenomenon whenever it may occur; indicating precisely the date and moment of their appearance, and their duration; the apparent size, colour and luminousness of these meteors; the direction in which they travel, their length of path, and the trains they leave behind; their greater or less multiplicity, and their presumed height; together with the state of the atmosphere at the time, and of the weather before and after: in short, he should observe everything which may tend to throw light on a subject as yet but imperfectly understood.

Fire Balls or Meteorites are probably of a similar nature with shooting stars; they, however, seem to come nearer to the earth. They generally explode, and the explosion is frequently accompanied by a fall of what are called meteoric stones. The nature of these is either earthy or metallic; the former are externally coated with a thin black vitreous crust, and, upon being broken, present a greyish mass of a granulated, earthy, and porous texture, intermixed with small crystals of olivine or pyroxene; the

whole very much resembling certain lavas. Those which are metallic are chiefly composed of iron and nickel, sometimes they are of pure maleable iron, the mass being full of holes like a sponge, and in some cases, thickly incrusted with small honey-yellow olivines.

The inflamed balls move with astonishing rapidity; their light is very intense, and when they are high, they illuminate a great extent of surface in the line of their passage. They are sometimes very large, and sometimes burst into a shower of fire: they have occasionally done considerable damage.

The traveller, whenever he may witness such phenomena should carefully note every circumstance regarding them; for, although they do not generally seem to be connected with the state of our atmosphere, and only appear occasionally, they deserve attention like all other phenomena of nature.

Lightning and Thunder.—Every one who has observed lightning knows that it presents different appearances; it is sometimes forked or darting in zigzag, straight or curved lines from the earth to a cloud, or from a cloud to the earth, and this is the most dangerous kind: sometimes the shock is only from cloud to cloud, in which case it is harmless. Thunder is no more than the noise produced by the sudden discharge, and re-echoed among the clouds. The colour of lightning differs considerably; it is sometimes white and sometimes of an orange colour, or of a rosy red, or blue, like the flame of burning sulphur. In summer we often see what is termed sheet lightning, unaccompanied by any noise. This is sometimes nothing more than the reflection in the clouds of lightning too far off for the discharge to be heard, and sometimes is the effect of a great rarefaction of the atmosphere, which, preventing the accumulation of the electric fluid beyond a certain limit, permits its diffusion among the clouds in lambent and noiseless flashes.

Some countries are much more subject to electrical discharges than others; thus, in Jamaica, it thunders almost every day, and there are places in North America, as at lake Huron, and other spots, where thunder is constantly heard. Thunder is also common in mountain regions, where, from the repercussion of the sound among the rocks, the effect is awfully sublime.

Thunder storms, by establishing an equilibrium in the electricity of the atmosphere, and otherwise purifying and

refreshing the air, are very beneficial. Thunder, it is affirmed, has a remarkable effect on fermenting liquors, on milk, &c.

The frequency of thunder-storms, the reason, and time of day when they happen, their duration, the nature, direction, and colour of the lightning, and its effects, should be attentively noticed by the observant traveller. Is the lightning observed to shoot up from, or to fall upon, particular spots? so as to induce the belief that particular objects at the surface, or the nature of the soil, or of the substrata, have any influence on the phenomena.

OPTICAL METEORS.—*The Rainbow.*—Whenever the sun's rays fall upon minute drops of water, as those of rain or the spray from a waterfall, or from dashing waves, or upon the dew on the grass, &c., they are refracted into the prismatic colours and reflected back to the eye of a person standing with his back to the sun, in the form of a coloured arch or bow. The rainbow is sometimes accompanied by a secondary one above it, of double the breadth, but in which the colours are in a reversed order, and much paler; besides these two bows, there are sometimes supernumerary ones. The semicircle is seldom ever complete, and whenever it is, it can only be when the sun is on the horizon. On high mountains a great deal more than the semicircle may sometimes be seen. Eccentric bows occasionally appear, they are due to the reflection of the sun's image in water. Lunar rainbows at times occur, though seldom, and when they are seen, are observed to be very pale, and generally to be merely of a yellowish white colour. Bows of this kind are sometimes produced by fog and are called *Fog-bows.*

Anything remarkable in the appearance of rainbows must, of course, be noted. It would be well in all cases to take the angular distances of the supplementary bows, when there are any, from the principal bow, and the angular height at which the bows, both principal and supplementary, cease to be visible.

Halos and Coronæ, and particular Appearance of the Sun or Moon.—Whenever light fleecy clouds, aqueous vapours, or small icy crystals, are interposed between the eye and the sun or moon, these luminaries are observed to be surrounded with one or more luminous rings, and sometimes exhibiting more or less vividly the prismatic colours: these rings are called Halos or Coronæ, though the latter name has sometimes been given to a particular modification of the pheno-

menon. Halos and Coronæ seem to be more common in some countries than in others. According to Muschenbroeck, they are extremely frequent in Holland; this frequency is worthy of notice. Halos are best observed by reflection in still water.

If the traveller be inclined to notice halos in detail, he must observe the number of rings, the angular diameter of each, the breadth of the rings, their colours, and the order of these colours with regard to the sun or moon.

Some halos have been seen that were elliptical, but Dr. Smith has shown this to be an optical illusion; nevertheless, whenever a halo appears elliptical, or the sun or moon not in the centre of the halo, the distance between the disc of the sun or moon and the halo must be taken in the direction of the four radii:—

In taking the angular diameter of halos the interior edge must be used.

The interposition of clouds and vapour does not, however, always produce halos; they sometimes only modify the appearance of the sun or moon, occasionally showing the sun merely shorn of his beams, his disc being white; sometimes they colour the disc; it has been seen of a blood red, of a bright blue colour, &c.: sometimes it is distorted, or magnified, particularly when near the horizon. Of these appearances, those which show the disc coloured are occasioned by dry exhalations. Singular appearances, then, of the sun or moon are worthy of observation, as they indicate particular states of the atmosphere, and, in some cases, are pretty certain prognostics of changes in the weather.

Parhelia and Paraselenes, or mock suns and mock moons, are occasioned by a complication of eccentric halos which intercept each other; the images, more or less bright, of the sun or moon being generally at the points of intersection; we say generally, for the images are sometimes seen in parts of halos not apparently intersected by any others. The halos are sometimes all complete, at others only a portion of some of them is seen, and sometimes not one perfect ring is observed. The diameters of the halos are generally about 45° or 90°.

Parhelia and Paraselenes are generally attributed to frozen vapour floating in the atmosphere, and are indeed seldom seen but in very cold weather. It is needless to say that whenever the traveller is so fortunate as to witness these at all times striking, and sometimes, very beautiful pheno-

mena, he should notice them in all their details; observing the date and time of day of the appearance, and the several changes it undergoes; the number, direction, diameter, thickness, and colours of the rings, or portions of rings; their distance from the sun and from each other; the angular dimensions of the disc of the sun or moon; the number, position, and angular dimensions of the images of the sun or moon; their relative brightness and colours, &c., together with the state of the atmosphere at the time, as to temperature, pressure, and humidity; the kind of weather which immediately precedes the phenomenon; and whether it be followed, and how soon, by rain, hail, or snow.* In the two latter cases, the form and transparency of the hail stones should be observed, and the crystallization of the snow. We have ourselves observed parhelia in Russia, and they were always followed by a fall of frozen spiculæ.

The Mirage is another optical phenomenon occasioned either by strata of vapour, or of air of different density. It was known to the ancients, being described by Theophrastus and Quintus Curtius. There are different kinds of mirage. Sometimes the phenomenon presents itself in the form of an extensive sheet of water, in which objects are reflected as they might be in a lake; sometimes the images of objects are seen reflected in the air either in their proper position or reversed, and occasionally both together. In some cases the images are fringed with the prismatic colours. These aërial representations are often seen when the objects themselves are not visible, or are even below the horizon.

The mirage is much more common than is generally believed: every one has heard of that seen in Egypt by the French army. The mirage is also known in Persia where it is called *Ser-ab* or *Sir-ab* (miraculous water); in the western deserts of India it is called *Tchittram* (picture). In the Sanscrit language it is called *Mriga-trichna* (thirst of the Gazel). Mr. Biot has observed the mirage at Dunkirk, and it is said to be not uncommon along the coast in the department of Calvados. Humboldt has observed it at Cumana, and we have ourselves seen it at the Cape of Good Hope.

It is however an error to believe that this phenomenon is peculiar to plains and to the sea. Jurine observed it on the lake of Geneva, where it was produced by the lateral reverberation from the mountains. It is also said to be seen among the Hartz mountains, in Hanover, and it has been observed on the Southerfell, in Cumberland, and elsewhere

in our own country. On the 16th July, 1820, the village of Great Paxton, with its dependencies, was seen as if suspended in the air. The inhabitants of Merou, in India, give to these suspended images, formed by refraction, the name of *Sikoté* (castle of the *Cold Season*), and the people of the plains, which are watered by the Tchembaul and the Jumna, call the mirage *Dissaser* (prognostic). Heat destroys the Sikoté. Wind prevents the appearance of mirage of any kind, and dissipates it when formed.

Colonel Todd has given a very interesting description of a vertical mirage which he observed at Hissar, where the inhabitants call it the *City of Rajah Hirchend*, a personage celebrated in the fabulous history of India. But, perhaps, the most remarkable mirage is that observed at Reggio, and known by the name of *Fata Morgana*. It has been repeatedly described. All those phenomena known by the names of the Enchanted Island, Cape Fly-away, the Flying Dutchman, &c., are so many effects of the mirage, or, as it is sometimes called, *looming*.

The traveller should not fail to describe exactly all the circumstances of the phenomenon whenever he may see it, together with the state of the atmosphere; and, if the mirage be over water or sand, their temperature, as compared with that of the air, should be observed.

Zodiacal Light.—This is a meteor which presents itself in the form of a whitish light, somewhat resembling that of the milky way. It is perceived in the heavens, at certain times of the year, after the sun has set, and before it rises. Its shape is that of a lancet blade or of an acute pyramid; it is confined within the limits of the zodiac, and seems to rest obliquely on the horizon. It is by some regarded as the atmosphere of the sun, and its pointed appearance is due to the direction in which we see its really lenticular form. Others consider it as a nebula revolving in the plane of the solar equator, and late observations seem to point it out as the source of those showers of shooting stars already mentioned.

The Zodiacal light is more or less visible according to particular circumstances, in the absence of which it is not seen at all. One of the circumstances the most favourable to its appearance is, that it extends sufficiently along the zodiac, and that the obliquity of the zodiac itself be not too great as regards the horizon, otherwise the zodiacal light

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will be absorbed in that of the twilight or the dawn. The point of the spindle-formed appearance is generally directed towards some star in the zodiac. It appears thus in the evening in the spring, and in the morning in the autumn; in the evening to the east of the sun, and in the morning to the west. Its two extremities may be seen on the same night about the time of the solstices, particularly the winter solstice, when the ecliptic makes, night and morning, nearly equal angles with the horizon, and these are sufficiently great to allow a considerable portion of the points of the light to appear above the line of the twilight. It is thus that it was observed by Cassini on the 4th December, 1687, at half-past six in the evening, and at forty minutes past four on the following morning.

The summer solstice has the disadvantage of a greater obliquity of the ecliptic to the horizon, and what is still more unfavourable, the inconvenience of a more extensive twilight; it is just the reverse with the winter solstice.

The zodiacal light must be more easily perceived in the torrid zone, and particularly near the equator;—1st, because in those countries the obliquity of the zodiac to the horizon is less; and 2d, because the twilights are very short.

The traveller will take notice of every circumstance relating to the zodiacal lights; he will particularly observe the constellations through which it passes, the star to which its point attains, and the angular breadth of the phenomenon at a given distance from, but near to, the horizon.

The Aurora Borealis has been so often described, that the various appearances it assumes must be known to all, notwithstanding which the real nature and cause of the phenomenon are yet a mystery. All that the traveller can do, when he may be in a situation to observe this singular phenomenon, is to note the day and hour, the appearances presented by the aurora, the manner of its commencement and termination, its duration, its extreme points, its angular extent, and height of the arch, as also the ordinary meteorological observations at the time, and the effect of the aurora on the magnetic needle.

Meteorological Observations.—Such, then, are the several phenomena termed, in general, meteors, and the observations the traveller should make on each. But isolated facts teach very little, and the observation of the phenomena which any particular meteor may present, is really interesting

only in as much as it is combined with that of all the other meteorological facts and circumstances which precede, accompany, or follow it.

In all the great cities of Europe, detailed registers are kept of the state of the weather and the meteorological phenomena; the object of which is to determine, by a long series of observations, the precise nature of the climate of the place, and to arrive as nearly as possible at a knowledge of the circumstances by which it is regulated. The traveller who changes place continually, cannot be expected to collect a sufficient number of observations, at any one place, to be of much use in determining the climate of that place, but the traveller who remains even a few days at any station, may collect data of great interest. The longer he remains at any place, the more important, *cæt. par.*, will his meteorological observations be; but he should omit no opportunity of making them at all times and places. In certain countries the climate, from a variety of causes, is almost exactly the same over considerable regions, in which cases, observations that are made at different points may be sufficiently characteristic of the whole; in other cases, again, the difference of one day's journey may bring the observer into an entirely different climate.

The principal objects which should engage attention are the temperature of the atmosphere, its electricity, its pressure, its humidity, and its movements or the winds; these it is which give rise to the meteors we have spoken of, and which, in their turn, modify the state of the atmosphere.

Order and regularity are essential not only in making meteorological observations, but in the method of registering them.

The Thermometer serves to point out the degrees of heat and cold; the Barometer, the atmospheric pressure; the Hygrometer, its moisture or siccity; the Anemometre, the force and direction of the wind; the Eudiometer, the quality of the air; the Pluviometer, the quantity of rain or snow which falls; the Electrometer, the kind and quantity of electricity with which the air is charged, and the changes which, in this respect, take place during storms and the passage of clouds. These several instruments will be found described in the section *Instruments*. They should all, as much as possible, be of the very best construction, and when

there are more than one of any kind, they should be numbered and compared, before they are used, with the standard instruments of some observatory, and a note of the differences made out in duplicate; one copy to remain at the observatory, and the other to be taken by the traveller; the reduction of whose observations to those of the standard instruments should not be made at the time of observation, but subsequently, and at leisure.

The following are the general recommendations and precautions drawn up by Sir J. Herschell for meteorological observations, and which the traveller cannot do better than observe strictly, as far as he is able:—

1. The continuity of observations ought to be interrupted, as little as possible, by changes in the adjustments of instruments, in their places, exposure, mode of fixing, or of reading off and registering them. Whenever any alteration in these or any other particulars takes place, especially such as are likely to affect the zero points, or otherwise to influence the mean results, it should be noticed in the register.

2. So far as possible, registers should be complete; but if, by unavoidable circumstances of absence, or from other causes, blanks occur, no attempt to fill them up by general recollection, or by the apparent course of the numbers before and after, should ever be made.

3. The observations should, if possible, all be made by one person; but as this may often be impracticable, the principal observer should take care to instruct some one how to do it, and should satisfy himself, by many trials, that they observe alike.

4. The entries in the register should be made at the time of observation, and the numbers entered should be those actually read off on the respective scales of each instrument; on no account applying to them, previous to entry, any sort of correction, as, for instance, for zero, for temperature, for capillarity, &c. All these and the like corrections, being matter of calculation and reasoning from other observations, are to be reserved till the final discussion of the series, and for separate determination and statement.

5. If copies be taken of the registers, they should be carefully compared with the originals by two persons, one reading aloud from the original, and the other attending to the copy, and then exchanging parts; a process always

advisable, wherever great masses of figures are required to be correctly copied.

6. The register of every instrument should be kept in parts of its own scale, as read off; no reduction of foreign measures or degrees to British being made; but it should of course be stated what scale is used in each instrument.

The times of observation will of course depend upon circumstances; Sir J. Herschel recommends sun-rise, noon, sun-set, and midnight; but many circumstances may render this inconvenient if not impossible. It is therefore proposed to observe three times a-day, at 8 in the morning, at 2 p.m., and at 8 in the evening. Other hours may be chosen, taking care only that they be precisely indicated, and that the morning and evening observations be at equi-distant intervals of time from the mid-day observation. When observations cannot be made at night, which it is very desirable they should, the traveller should employ, if possible, those instruments which mark the maxima and minima in the absence of the observer.

It is further recommended to observe four days in the year, hourly throughout the whole twenty-four hours of these days, and the adjoining six hours of the days preceding and following; the days fixed upon are the 21st March, the 21st June, the 21st September, and the 21st December, unless any one of these days should happen to be a Sunday, when the observations are to be made on the 22nd. The observations to commence at six o'clock a. m. of the appointed days, and terminate at 6 p.m. of the following, according to the usual reckoning of time at the place. The observations should be made at the commencement of each hour, and in all cases the precise hour and *minute* of each reading should be expressly noted. In registering meteorological observations, the longitude, latitude, and height of the station above the level of the sea should always be stated when known.

All observations must be registered as soon as made, each in its appropriate column. In that headed *State of the Heavens* will be marked the state of the weather, as fine, cloudy, rainy, &c.

In the column of *Particular phenomena* will be registered the occurrence of storms, thunder, &c., the appearance of rainbows, halos, the aurora borealis, &c.: and under the head of *Remarks* will be inserted all details worthy of notice, the formation of clouds, the shape and size of hail-stones,

the forms of snow crystals, the duration of the different phenomena, &c.

With regard to the Eudiometer it may be remarked, that as experiments often repeated give in all places nearly the same results, it is hardly necessary to make regular observations with this instrument. It need only be used, whenever there is reason to believe that particular circumstances may have had some influence in changing for a while the constitution of the atmosphere, and then the results of the experiments may be consigned to the column of remarks.

Few travellers, as we have already observed, remain long enough in one place to make any extensive series of observations, they will therefore have little occasion for calculating means; if, however, the great number of observations made at the same place, should render this desirable; it may be done if the individual be accustomed to the operation; if not, he had better leave the general results to be worked out by those who are better versed in these matters.

Independent of the meteorological observations, properly so called, which we have just enumerated, there are other phenomena bearing relation to climate which are particularly worthy of the traveller's attention, if time and other circumstances will allow him to examine them. These are the temperature of the earth, and the terrestrial magnetism.

TEMPERATURE OF THE EARTH.—There is much diversity of opinion regarding the cause of the heat observed at the earth's surface. By some it is attributed to fire in the bowels of the earth; by others it is conceived to be derived from the sun's calorific rays; and some suppose it to result from a particular modification of subtile matter set in motion by the luminous rays of the sun, while others again attribute all to the agency of electricity. It would be foreign to our purpose to discuss these opinions. The facts seem to be, that the sun, either directly or indirectly, is the grand source of heat, though the existence of subterraneous fire is indisputable. Thus both the sun and terrestrial fire contribute to the temperature of the earth, with this difference, however, that the influence of the sun seems limited to very insignificant depths below the surface, beyond which, the heat increasing downwards, seems due to subterraneous fire. The limit between the two influences, that of the sun and of the earth's own heat, forms a zone of uniform temperature, the depth of which from the surface is different in different places: generally speaking it is

deepest in the region of the equator, and comes nearer to the surface in the neighbourhood of the poles ; but local circumstances intervert this order in many places. On the one hand, the depth to which the sun's calorific influence extends differs with the latitude, the longitude, the height above the level of the sea, and the particular aspect of the place ; and it is still further modified by the nature of the soil, and the vegetation at its surface. On the other hand, the proximity or remoteness of volcanic fire, the number, direction and extent of the subterranean flues, conveying hot air, vapour, or thermal water, and the greater or less conducting power of the mineral masses which compose the substrata of the earth, all tend to produce irregularity in the form of the zone of uniform temperature. Above this zone the temperature of the earth varies at the same depths in different places, and at the same place in different seasons. For each place, however, there is a mean annual temperature ; and from experiments and calculations already made, it is found, that several places have the same mean annual temperature ; lines drawn through these are termed *Isogeothermal* lines ; and lines drawn through those parts of the earth where the mean annual temperature of the air is the same are called *Isothermal* lines. According to Mr. Kupffer, the isogeothermal and isothermal lines correspond at about 45° of latitude in our hemisphere. From this towards the equator the temperature of the soil is inferior to that of the air ; whereas from the same parallel towards the pole the mean heat of the soil is greater than that of the air. The geothermal equator, or the line joining the places where the mean annual temperature of the earth is greatest, does not coincide exactly with the equator of the earth, nor is it a regular great circle ; it is an irregular curve, and so are all the isogeothermal and isothermal lines, owing to local influences.

The mean heat of the earth above the stratum of constant temperature is determined by actual observation, and by deductions from the observed temperature of springs. We have already recommended the temperature of springs to the particular attention of the traveller, and we reiterate the recommendation here : the method of observing the temperature of springs is given in the section OPERATIONS. The method of deducing the temperature of the soil from that of springs is by algebraical formulæ, which it would be foreign to our object to detail. The temperature of the

soil may be taken directly by thermometrical observations. For the details, see OPERATIONS.

A separate register will of course be kept for the temperature of springs and of the earth directly, and every circumstance which can be supposed in any way to influence that temperature must be carefully noted.

We must not omit, in speaking of the temperature of the earth, to point out the desirableness of making observations, in polar regions, on the thickness of frozen soil. Late observations have proved that, in high northern latitudes, the soil is permanently frozen to a very great depth, and that the effect of the summer's heat is limited to the thawing of the surface a very little way down. Observations, therefore, on this subject should be made whenever the traveller finds himself in countries where there is reason to believe that the soil is permanently frozen. For these experiments, wells must of course be dug, and if possible continued till the whole layer of frozen soil be passed. The thickness of the frozen stratum must be observed, and the nature of the soil, as also the different effects produced by the cold at the different depths attained, and in each different kind of soil that is passed. The frozen soil should be observed with a magnifying glass, in order to discover the mode in which the moisture in the earth is frozen. Are any continuous sheets of ice met with? or is the whole mass interspersed with minute crystals of frozen water? What is the precise situation in longitude and latitude of the spot where the experiment is made, its height above the level of the sea, its aspect as regards the sun, and the nature of the vegetation, if there be any, at the surface? The time of the year must also be noted, and, should the surface be thawed, at what depth?

TERRESTRIAL MAGNETISM.—Three things are to be observed regarding terrestrial magnetism; 1st. the variations of the needle, 2nd. the dip, and 3rd. the magnetic intensity. These operations, to be nicely performed, require time and conveniences not always at the traveller's disposition; they also require instruments constructed expressly for the purpose, and which, in long travels by land, are liable to be injured, and rendered useless. We have, therefore, merely described in the section INSTRUMENTS (which see) such as are the most simple; the compass and dipping-needle. Observations with these are easily made, and though they may not have all the importance of observations made

with the more delicate apparatus, and greater regularity employed in observatories, they may still be of great interest. Those who intend observing terrestrial magnetism with all possible nicety, must serve a kind of apprenticeship to the task; that is, they must undergo a regular course of instruction for the purpose. Such a course we cannot detail here, and, to treat the subject superficially, would be of no use. In the section OPERATIONS we have, therefore, given merely what information is necessary for observing with the ordinary instruments.

DIVISION II.

PRODUCTIONS OF A COUNTRY.

SECTION I.

GEOLOGY AND MINERAL PRODUCTIONS OF A COUNTRY.—Adequately to describe the geology of a country the traveller must be a geologist, and a geologist requires no instruction from us. On the other hand, nothing short of a complete treatise on the subject could be of any use to one wholly unacquainted with minerals, and with the way in which they are distributed over the earth. Nevertheless, as it would be absurd, in a work like the present, to say nothing of the observations to be made by the traveller on the geology and mineral wealth of the country he explores, we shall first call his attention to what must be observed regarding the distribution and arrangements of the great mineral masses of a country, and then enter into a few of the more interesting particulars of such of these masses as are of the greatest importance.

If the country over which the traveller wends his way be flat, or slightly undulating, it will generally be found to be covered with alluvial deposits, or a mixture of these and diluvium; but not unfrequently formations of a much older date spread along over the plains or crop out on their surface.

Now, be the nature of the soil or rock what it may, the traveller must note it, and mark off upon his map the points in various directions, as far as is practicable, where the soil changes to something else, which he will note in like manner, and so on in succession. If the same rock or soil continue over a great space, it is evidently, unless in the case of an unstratified rock, a horizontal or nearly horizontal bed, stratum or deposit. If, on the contrary, the rock or soil changes frequently, the traveller is evidently crossing over the out-croppings of inclined strata, &c. In this case he

must note the breadth of the bands as he passes them, and the direction, true not magnetic, in which they trend. Be it observed, however, that the breadth of the bands differs from the thickness of the strata in all cases, except where they are crossed in a direction perpendicular to the planes of stratification.

While making his observations regarding the superficial distribution of the mineral masses of the plain, he will look out for, and examine, as many sections of the soil as possible. These are, generally speaking, of little importance in flat countries; not because they are rare, but on account of their want of depth; being generally confined to the banks of rivers, and the little gullies which join them. Wells, shafts of mines, and other deep artificial excavations, are the only places in which the succession of the strata in flat countries can be satisfactorily observed. If, however, the plain border on the sea, and be at the same time considerably raised above it, the cliffs may assist, in some measure, in furnishing a knowledge of the internal arrangement of the soil.

But it is in hilly and mountainous regions that the positive and relative positions of mineral masses, their succession, the dip and strike of the several strata, their thickness, parallelism, faults, contortions, fissures, veins, &c., are studied with advantage. There it is the intelligent traveller may see the stratified reposing on, or leaning against, the unstratified rocks; there he will distinctly see the difference between conformable and non-conformable strata; observe the granites and porphyries and trapp-rocks injected, as it were, between the strata of the over-lying and more recent formations, ramifying through their masses, and filling the vertical fissures through which they have risen in a fluid, or semi-fluid state, to spread over the surface: in a word, there, amid the picturesque, the sublime, or the terrific scenes of nature, he will gain some insight into the blended order and confusion which have presided over the constitution of the earth's surface.

Let him seek the bold cliffs of the barren rock, the ravines, the gullies, the beds of torrents, the slips, the chasms, in short, the natural sections of the mountains, and there note, with minute exactness, and on the spot, all he sees.

And here let us caution the inexperienced traveller against certain deceptive appearances.

Accidental fissures in unstratified rocks may sometimes give them an appearance of stratification; a close examin-

ation, however, will presently show that they want the parallelism and extent which is observable in real strata. A stratum of extraordinary thickness, when but partially exposed, may lead to the belief of the rock being unstratified; the observer must be on his guard and examine closely.

In like manner, if, in vertical or highly inclined strata, the traveller see only the plane or surface of a stratum, instead of its section, he may be deceived into a belief that the rock is unstratified; he must therefore go round, and if possible get a sight of a section at right angles to the former position.

Where stratification is evident, the inclination of the strata may be erroneously concluded from a partial observation; thus beds, in reality very much inclined, will appear horizontal if they are seen at a section formed by a plane whose intersection with the horizon is parallel to the strike of the strata. Their true inclination can be judged of and measured with certainty only at a section whose direction is *perpendicular* to the strike.

When contemplating stratified rocks, the superficial observer may be led into error by the lines which result from the "cleavage" of the rock. These clefts are sometimes at right angles to the planes of stratification, and sometimes form acute angles with them; sometimes they are very distinct and regular, so that on a hasty view it is not easy to determine the strata. In such case the traveller must look for some stratum or bed differing altogether from the others in its nature or in its constituent parts, or in the arrangement of those parts, their size, colour, &c. The direction of such particular bed will point out which are the lines of stratification, and which are those of cleavage. In rocks of a slaty structure, such as gneiss, mica-slate, &c., the direction of the laminæ being parallel to that of the beds, the latter is pointed out by the former.

While on the subject of strata we may say a word on *faults*, which are the dislocation, or slipping downwards or sideways, of a part of the strata. The faults are sometimes only lines or cracks, as it were, on either side of which the corresponding strata are displaced. Sometimes the faults gape, and form chasms of greater or less width; sometimes filled, and sometimes empty. Whenever faults are met with, the extent of the vertical or lateral dislocation must be noticed, and the dip and strike of the fault, stating to what distance the latter has been traced.

The distortion of the strata, whenever such is met with, must also be noticed, and everything connected with it.

Having attended to these precautions, the traveller will proceed in his observations: the method of taking the dip, strike, &c., of strata is detailed in the section OPERATIONS. Independent, however, of the dip, strike, and thickness of the beds of stratified rocks, the traveller must observe their order of succession; beginning either at the bottom and proceeding upwards, or at the top and going downwards, as most convenient, not forgetting however to state which order he adopts. In beds that are repeated, are the minerals which form them exactly similar, and aggregated in the very same way; are they of the same colour and the grains of the same size, &c.; that is, are the repeating beds exactly alike, or if they differ, in what does the difference consist? perhaps it may be merely in the absence or presence of some accidental mineral.

Does any particular stratum differ from itself in different places? Is the difference observable in the direction of the thickness of the stratum, or in the direction of the strike, or of the dip, or in any two or all three of these ways? Is the difference sudden and complete, or gradual, and at first imperceptible? Does it ever amount to a complete change in the rock which, thenceforward continues unaltered, or do the various appearances occur in patches, or, as it were, imbedded masses?

Are the various strata of a series perfectly distinct, or do they all, or any number of them, pass insensibly into one another?

In proceeding along the line of strike, or in a direction perpendicular to this, is any stratum observed to thin out and disappear, so that two strata before separated by an intervening stratum come into immediate contact; or, what is in fact the same thing, are any two contiguous strata seen to open out and admit between them a third before unnoticed? What is the stratum that disappears, or that comes into sight, and do the strata themselves change in their character at the places where such circumstance occurs? Non-conformable strata must be particularly attended to. Not unfrequently horizontal beds repose on vertical or highly inclined, or twisted and contorted, strata.

What is the nature of the faults, slips, or rents of the strata? When rents are filled with solid rock of igneous

formation, such as granite, trapp, and lava, which has been forced up in a fluid state, they are called dikes; the traveller should observe the nature and dimensions of these dikes, and if, which is often the case, the strata which they traverse are any way altered at the parts where they are in contact with the dike, what is the nature of the alteration, and to what extent does it reach on either side in every different kind of stratum traversed? The dikes themselves are sometimes broken and displaced by a fault in consequence, of course, of some movement of the strata since the formation of the dike; such facts must be carefully noticed.

The clefts of rocks are sometimes filled with loose materials, lined with crystals and certain metals. The following observations should be made on the clefts:—Are they empty, or partly empty and partly filled, or quite filled? Are the substances found in them 1st. fragments of the various materials which compose the rocks; 2d. minerals which enter into the composition of the rocks as aggregates or elements; 3d. substances of one or more kinds quite different from those which constitute the rocks; or, finally, 4th. a mixture of two or more or all these? In the case No. 1, the substances will be in the form of fragments, and may be angular, water-worn, or both: they will in general be loose, or cemented together by clay, if water charged with such finds way into the fissure. The order in which the fragments are found, may be either the same as that of the superposition of the strata of the mountain, or in an inverse order, or indiscriminately mixed; the first is the most common; but, as the latter would indicate singular commotion, it must be noticed when it exists. In the cases 2, 3, and 4, the substances may adhere to one or both sides of the cleft as an effervescence, or in the form of concretions, or crystallizations, or they may fill up the space in the form of a pasty mass, or in fragments, or sand, &c.

Whenever a vein or fissure is not completely filled, but has clayey or agglomerated matter of any kind adhering to its two sides, the surfaces of such clay, &c., should be narrowly inspected, in order to see if the two sides of the existing opening correspond or not; for if they do, it is a proof that a fresh gaping of the chasm has occurred since the substance now found in it was there deposited. I need hardly say, that, as many of the metals and more precious minerals are found in veins, the curious traveller will not

fail to examine these, and discover, if possible, some unknown treasure.

But to return to the rocks themselves; many are fossiliferous, and such are of peculiar interest to the speculative geologist. The traveller should not neglect them, on the contrary, he will carefully note the beds containing organic remains: if he be master of zoological and botanical geology he will of course know what details to enter into; if not, he will still be enabled to distinguish between vegetable remains, and those of fishes, reptiles, corals, shells, &c., and whether the latter be bivalves or univalves, or both; or marine, or fresh water, or terrestrial; he can observe whether the fossils are perfect, or broken, or flattened; if they lie in any particular direction, and which; if they are disposed in beds parallel to the stratification, or confusedly mixed together without order, if they are in great number in any particular bed, and nearly, or altogether, wanting in other beds though of the same mineral composition; whether the same fossils occur in beds of different mineral composition, &c. He will do well to take specimens of the different fossils, noting carefully the beds in which they were found and the apparent proportions in which the several fossils exist in the different beds. For the mode of collecting specimens, see APPENDIX.

The theories and system which may be deduced from the various Geological facts observed, do not come within the limits of our work, nor can we even enter into the details of all that it is necessary to observe. Many of the facts termed geological, belong to physical geography generally, and will be found dispersed in different parts of the present book. We shall now proceed to say a few words on the several mineral masses which may come under the notice of the traveller. Vegetable soil, though of the greatest importance, belongs more particularly to our sections on AGRICULTURE and VEGETABLE PRODUCTION, it will therefore be found treated of under those heads.

Commencing then at the surface, and proceeding downwards, we find the following succession, which has been variously divided according to the different views of the several writers on geology:—

At or near the surface we find, without being arranged in any regular order, a variety of mineral masses, some loose and others consolidated; some deposited by mere mechanical agency, others by chemical precipitation; some

indurated by simple pressure and dessication, others formed of particles agglutinated by a substance of a nature sometimes similar to, and sometimes different from, their own; some formed by subterranean fire, others by a peculiar process of vegetable decomposition in water, &c., but all derived from causes now in action.

Of these recent formations we may notice the following: The modern débris accumulated against the basis of escarpments forming various degrees of slope, and following more or less exactly the contour of the escarpment, or heaped up in cones more or less acute in the front of, and immediately below, gorges and channels, whence the materials have been, or still are, precipitated by running water; Fluvial, Lacustrine, Marine, and Estuary deposits; Sandy Dunes; Peat; Bog Iron-ore; Calcareous Tufas and Travertinos; Calcareous sand-stones with broken shells; Conglomerates of various kinds, &c.

Mixed with these, though not produced by causes now in action, but referable, on the contrary, to a very different order of things, we find what is termed Deluvial débris or Diluvium, such as Sand, Erratic-blocks, Boulders, and Fossil remains of antediluvian animals; Osseous Breccias; Pisolitic Iron-ore, &c., &c. All those various formations, which are frequently intermixed at the surface of the earth, though they belong to two distinct epochs, are worthy the attention of the traveller; we shall therefore point out to him some of the principal observations it is desirable he should make on them.

Slopes and Cones of modern débris are produced solely from the rocks immediately above, or from rocks at a distance, or from both. What is the particular nature of the débris; that is, what are the minerals, and in what state are they? as sand, rounded or angular, gravel, or large angular fragments, or a mixture of all these, together with clay, earth, vegetables, animal carcasses, &c. How are the different materials mixed up; are the larger masses at the bottom of the slope, or towards the top, or is all blended together? These differences depend on a variety of circumstances, but principally upon the accumulation being formed by dry crumbling from above, or by water transport.

The débris found at the base of sea-beaten cliffs is formed in a very different way from the slopes and cones above mentioned; they result chiefly from the undermining, and subsequent falling down, of a part of the cliffs, and, according

to their nature, remain for a shorter or longer time in the places where they fall. Sometimes causes similar to those above mentioned may increase the mass, and sometimes the sea throws up a quantity of sand and shingle, as if to repair the breach it had made.

Fluvial-deposits.—What is their nature? as mud, sand, clay, gravel, &c.; what the situation and actual extent of the deposit; the annual increase; the mode of deposition; the organic remains imbedded in the deposit, &c.? See also the articles *Delta*, *Débris*, *Islands*, *Shoals*, *Fluvial-lagoons*, and *Inundations*.

Lacustrine-deposits differ from those formed along a river's course, only by the circumstance of their being thrown down in still water. The same kind of observations as we have just pointed out for Fluvial-deposits, are applicable to Lacustrine-deposits.

Marine-deposits also require similar observations; but here it must be remarked, that the way in which the sea acts in depositing its sand and shingle, is different from the action of rivers. The direction in which the Marine-deposit extends, depends upon the combined circumstances of the trending of the coast lines, and the direction of the currents and prevailing winds. The extension of the deposit in a given time will depend upon the quantity of detrital matter with which the sea is charged, and the slope of the beach on which it is deposited. In other respects, the observations to be made are the same as those above stated.

Estuary-deposits are formed by the combined action of the tides of the sea and the currents of rivers. The detrital matter, after being alternately carried out seaward by the rivers and driven back by the tide, is gradually borne away to the more quiet parts, or to the spots where eddies and counter-currents exist, and is there finally deposited. The materials of such deposit will, of course, partake of the double nature of fluvial and marine detritus; and, in the mass, the organic débris brought down by the river will be entombed together with salt-water testaceæ and fish, and marine plants, &c. The observations to be made regarding the particular nature and extent of the deposit, its annual increase, &c., will be similar to those for the other deposits already mentioned.

An observation to be made on all sedimentary deposits is, the degree of consolidation they acquire, and to what cause this consolidation is owing; sometimes ferruginous particles,

and sometimes lime, forms the cementing ingredient. What is the rapidity of the consolidating process?

Dunes are hills of sand blown up from the sea beach. These hills seldom attain a height of 150 feet, but they are, unless arrested in their march, observed to gain continually upon the land. Nature sometimes fixes them, as in the case of some of our dunes on the east coast of the island, where the creeping roots of the *Arundo Arenaria* fixes them into a compact mass. These dunes sometimes form one or more continuous ridges, and sometimes groups of detached hills. Their direction depends greatly upon the relative direction of the coast and the prevailing winds. The inland side, or, more properly, the lee side of these eminences, is generally the steepest. The nature of the sand should be stated, and whether or not it be mixed with shells, broken or whole. If stones are found in them, their size should be stated, as showing what transport may be effected by wind. The extent of the dunes, and their height, &c., must be stated. For further observations, see the article SEA.

Calcareous Sandstone with broken Shells.—This is a recent formation still in progress, as on the coast of Sicily, &c.; but it is particularly remarkable at Guadaloupe, Sandomingo, and other of the West-India islands. This rock is composed of fragments of shells, and corals, and sand, washed up by the sea, which partly covers it at high water. The lime, it would appear, cements the whole into a compact mass, which acquires great hardness. In it are found the recent shells of the surrounding sea, as also some land shells of the island, and, what renders this formation particularly interesting, embedded human bones.

Whenever the traveller may meet with such a formation, he will not fail to examine it with attention, noticing the superficial extent of the formation, and its thickness, as also the rock on which it reposes; the substances embedded in it; and, if still in progress of formation, the rapidity of the process, &c.

Calcareous Tufas and Travertins.—Among the rocky masses whose formation belongs to the most recent period, and may yet be observed going on before our eyes, are the various kinds of calcareous concretions. The tufas are stony masses, generally porous, pierced with holes and cylindrical cavities, and often either exhibiting the impressions of the leaves and stalks of plants, or enveloping the vegetables themselves, as also fluvial or terrestrial shells, and bones, and

even products of human art. Some tufas are sufficiently compact and hard to be used as building stones. The travertins present a closer-grained fracture than the tufas, and sometimes have an oolitic texture, or are formed of large spheroidal masses composed of concentric layers. The colour of tufas and travertins is sometimes white, sometimes grey, and sometimes yellow, and the travertins are occasionally traversed by veins of coloured Spar, of Arragonite, and Siliceous-nodules.

The formation of both kinds of calcareous concretionary masses is owing to the acidulated waters, both cold and thermal, which held the lime in solution, coming in contact with the air, by which they lose their excess of acid, and then let fall or deposit the calcareous matter. The situations in which calcareous concretions are formed are very various, as at the bottom of lakes and marshes, on the sloping sides of valleys, capping hills of a certain height, covering the rocks of volcanic islands, filling the rents and chasms of rocks along the sea-coast, and the cavities of certain amygdaloid rocks in the same situation, hanging in stalactites from the roofs of caverns, or rising in stalagmitic masses from their floors, and sometimes filling them entirely with alabaster, sometimes white or honey yellow, but more frequently coloured in veins and clouds of various ochre or reddish tints.

The modern tufas and travertin rocks are sometimes of considerable extent, their thickness being from 400 to 500 feet, and covering an area of a mile or two square.

The observations to be made on these deposits by the traveller are the following:—the situation, superficial extent, and thickness of the deposit; its particular nature, colour, hardness, texture, &c.; the rocks it immediately reposes on, and whether anything repose upon it, and what; the organic bodies or other substances that are found in it; the uses to which it is or may be applied. Is it still in process of formation? and, if so, describe the nature of the spring, or of the lake, &c., whose waters contain the calcareous matter. If it be a spring, what quantity of water is produced in a given time? and if the water be warm, what is its temperature? What thickness of calcareous matter is annually deposited, and over what extent of surface? If the travertin be deposited by the waves or spray of the sea on littoral rocks, and in the fissures of cliffs, to what extent, and under what form, does the deposit exhibit itself? and what is the

progress of its formation, &c. As to what regards stalactites and other calcareous concretions found in caverns, see the article CAVERN.

Peat Bogs.—We have already said a word on marshes, and hinted that some of them are valuable by reason of their turf or peat; but as this substance, though of vegetable origin, is usually arranged with minerals, it will be necessary to enter into a little detail regarding the observations to be made on this interesting formation.

Does the peat hang upon the hill slopes, or is it found on the table lands, or in the higher mountain valleys, or in the plains along the foot of the hills, by the side of rivers, or at their mouths, or in isolated patches? What is the superficial extent of the peat bog, and the depth of the layer or stratum of peat? Is the peat covered with vegetation, and of what kind? or is it covered by a superstratum of sand, or gravel, or sedimentary mud, or clay, or vegetable soil? and, in either of these cases, what is the thickness of this superstratum? What is the nature of the substratum below the peat? If the peat be of a very spungy nature, is it observed to be swollen, so as to rise above the ordinary levels of the surrounding soil, or does it bulge up towards the middle only? Is the peat bog covered with a treacherous surface of apparent solidity, but which easily breaks in, so as to engulf those who venture upon it, or may the bog be fearlessly and safely crossed, though quaking beneath the tread?

What is the nature, colour, and degree of compactness of the peat generally? does it change character in proportion as the depth increases, and what is the nature of the change? (it sometimes passes into lignite). Are the vegetable forms so far preserved in the peat as to enable us to recognise them? are any large vegetables found in the peat, such as whole trees and shrubs? and, if so, what is the nature of these, their abundance or rarity; the manner in which they are found, as upright, or inclined, or horizontal, broken, or whole, lying in various directions, or in the same, and if so, in which direction; what is the appearance of the buried timber as to colour, consistence, &c., and the depth below the surface at which such buried timber is found? Are any animal remains discoverable in the peat, and if so, of what kind are they? do they belong to species existing in the country or elsewhere, or to extinct species? Are any works of art found in, or buried beneath, the peat, and if

so, what are they, and to what date do they point? Is there any historical or traditionary evidence of a time when there was a forest, or fields, or roads, or a lake, &c., on the spot now occupied by the peat bog? if so, state the circumstances and the degree of confidence to which such evidence is entitled. Is there any self-evident cause in the topography of the place, and its hydrographic arrangement, to account for the formation and existence of the peat bog? Is the bog known to extend gradually, or has it, as far as is known, been always of the same extent, or does it appear to diminish? Is such diminution to be attributed to a diminished supply of water, or to the gradual encroachment of contiguous sands? a process very common in Poland and Lithuania. Is the peat turned to account as fuel, and if not, why so? Is it employed as a manure for arable land, and, in such case, how is it used? Whether dug up for fuel, or with a view to clearing it away from a rich substratum, in order to cultivate the latter, the mode of draining, cutting, &c. must be noticed by the traveller; particularly if it present any thing new or remarkably ingenious and effective. Some kinds of peat resemble rather a black mud than a spungy mass, and, in this case, it is sometimes dragged up, put into large boxes pierced with holes, for the water to drain off, and is then moulded into the form of bricks or of round cakes; in such case the process should be noticed. Peat is sometimes charred, and, in some cases, considered preferable to ordinary charcoal. When incinerated the turf ashes are very good for sour meadows. Peat, it is said, by distillation produces an oil useful in the arts.

In Norway, Peat is used in the construction of dams and embankments, by placing it between two stone walls; for when peat is saturated with water, it allows no more to pass through it.

There is a species of pyritiferous peat, which, by incineration and lixiviation, furnishes sulphate of iron and alum. We are informed by Roland de la Platrière, that the ashes of pyritiferous peat, when mixed with lime, forms a cement to be used under water preferable even to Puzzolana. In a word, whether as a part of the mineral riches of a country, or as interesting to agriculture, peat and peat bogs are entitled to the particular attention of the intelligent traveller.

Bog iron-ore.—In the same kind of low places, in valleys and plains, where peat and bituminous wood are found, there

not unfrequently exists patches, pans, or cakes of iron-ore, which, from its usual situation has been called Bog or Morass iron-ore. As it sometimes lies below the peat, it is not discovered unless sought for: at other times it fills depressions now dry, where it is also concealed beneath a stratum of sand, clay, loam, or vegetable soil: occasionally it lies on the surface and is then easily recognised. As this hydrate of iron is more or less mixed with clay, its colour is usually a yellowish brown; and from earthy and friable, it passes into compact, and sometimes has even a metallic lustre when broken. In some places it exists in grains of various sizes and forms; in others, in irregular lumps full of holes and contortions, mixed with vegetable débris preserving organic forms but converted into iron-ore. Sometimes the whole mass forms but one vast cake, but completely honeycombed; this kind is sometimes very rich in metal.

There is another kind which belongs equally to alluvial soil, but is more frequently found filling the chasms of certain rocks, than horizontally deposed in the hollows of plains and valleys. This kind is sometimes very finely granular or oolitic, and sometimes in large oval or kidney shaped lumps.

The observations to be made on beds of Bog iron-ore are: The surface extent of the deposit, and the medium depth of the stratum, or rather cake, and the colour, quality, and appearance of the ore. Is the manner of its formation easily accounted for, as by precipitation from ferruginous springs, or by direct transportation from neighbouring ferruginous rocks and soil, &c.? Is the deposition now going on, and that so abundantly, that, after taking it all away, an equal quantity is again deposited; as is the case in some parts of Norway and Hanover, at the lake Balaton, &c.?

Bog, Swamp, Morass, or Meadow-ore (for according to circumstances it receives one or other of these names), is abundantly used; but as, in consequence of the phosphorus it contains, the iron it produces is brittle, it is seldom employed but for cast work. In some cases, however, this kind of ore produces excellent iron, and no considerable deposit of this valuable metal should be passed over in silence by the traveller who would note the various resources of a country.

Conglomerates, Sandstones, and Breccias.—The rocks so named are of various epochs, but many of them are mo-

dern. When rounded and angular fragments of various forms, size, and nature, are cemented together, the rock is a Conglomerate or Agglomerate. When the rock is an agglutinated sand, it is called Sandstone. If the cemented stones are rounded, the rock is a pudding-stone ; but if they are broken into sharp angles and edges, it is a breccia. The cementing substance is either calcareous, argillaceous, siliceous, or ferruginous, or some compound of these, and the rock is named accordingly a Siliceous-conglomerate, a Ferruginous-sandstone, &c. These rocks frequently envelop organic and other bodies ; their induration is sometimes so considerable that the mass is quarried as a building stone or for other purposes. In many places the process of formation and induration is still going on.

What we have said of other modern formations, will suffice to point out to the intelligent traveller, the nature of the observations to be made on modern Conglomerates, Sandstones, &c.

It may be well to remark in this place that, when rocks of a similar nature exist, such as many of those of the diluvial and post-diluvial epochs, they can seldom be confounded by the traveller if he consider the situation in which they exist, and the nature of the organic remains they contain, and the limit of power of causes now in action.

Osseous Breccia.—In the clefts and caverns of calcareous rocks is sometimes found a mass of agglutinated fragments of stone, &c. intermixed with bones of animals ; some belonging to animals now extinct, and others to species now found living only in intertropical countries. These formations belong to the diluvial epoch, and when such deposits are met with, their nature and extent must be described, and, if possible, specimens of the various bones brought away. See *Caverns.*

Pisolithic Iron-ore.—This kind is found filling certain clefts in the limestone of Jura and elsewhere. It is composed of minute round grains, and, from its situation, must be of the diluvial epoch and cannot be confounded with modern alluvial deposits. The extent and situation of the deposit should be mentioned, as also, whether or not any fossils are found in it.

Saline efflorescences and superficial deposits of muriate of Soda, of Natron, &c.—The traveller may occasionally have opportunities of observing the saline efflorescences which cover certain rocks and soils ; these may be common

Salt or Muriate of Soda, Natron or Carbonate of Soda, Borax or the Borate of Soda, Sal Ammoniac, or the Muriate of Ammonia, Alum or the Sulphate of Alumina and Potash, Saltpetre or the Nitrate of Potash, &c. Of these the more important are Common Salt and Natron; Borax, Sal-ammoniac, and Alum are also very important, but they are seldom found in large quantities. Common salt, on the contrary, not only exists as an efflorescence but is found forming certain superficial crusts of great thickness. It may suffice to remind the traveller generally, that wherever he finds such efflorescence or accumulation of salts, he should describe the situation, the nature of the rock or soil on which the salt is found, its kind and its abundance, the circumstances attending its formation, and, if it be collected, in what quantity.

Sand and Gravel.—Sand, independent of its mixture in greater or less quantity with different soils, forms of itself immense accumulations, covering great extents of surface, such as sea beaches and low plains; it is also found on high table lands, in mountain valleys, in the beds of lakes and rivers, filling veins and chasms in rocks, or piled up in cones at their base, and finally, it forms beds in different series of stratified rocks. Having noted the locality, the following observations should be made on the sand itself.

Is it exclusively composed of grains of quartz, or is it a mixture of comminuted particles of various substances? and if so, what are the substances, and the relative proportions in which they exist? A sand is sometimes met with composed wholly of the detritus of some particular rock, as granite or syenite, or mica-slate, &c.: mixed up with the sand, there is not unfrequently found fragments of shells, corals, &c., so minute, in some cases, as only to be discovered by the aid of a lens. What is the colour of the sand in the mass; of what size are the grains, that is to say, is the sand very fine, fine, middle sized, coarse, or very coarse? are the grains angular or rounded, or mixed of both kinds? If the sand be stretched out over a valley or plain what may be the depth of the sandy bed? Is its surface formed into hillocks, or into regular ridges like the waves of the sea; if in hillocks are these observed to advance after the manner of dunes or do they remain stationary? if there are ridges what is the direction of these ridges? Does the sand appear to be the detritus of rocks close by, and brought down and deposited by causes now in action or the contrary?

The uses of sand are very numerous in the arts. Pure white quartzose sand is particularly valuable for the finer kinds of glass. The sharp or angular sands make the best cement, but if they are impregnated with salt, they must be washed before they are used in the composition of mortar for building. Sand is frequently mixed with gravel, which, like the sand itself, may be of one particular kind of stone or rock or a mixture of several kinds.

Gravel should always be examined if the traveller have time. Are the stones all nearly of one size, or, if they differ, is there any relation between the sizes and the nature of the stones, or is the same kind of stone, formed of all sizes? Of what kind of stones is the gravel formed? Is it of the same kind as, or different from, what composes the sand that is mixed with it? Is the gravel regularly intermixed with the sand or does it lie in ridges or patches in particular places? Are the stones which form the gravel very smooth and rounded or are they rough and angular? Observe if the long or oval stones lie all the same way, and, in that case, what is the direction of their shorter axes.

Gravel, unlike sand, is of little use in itself unless for making and repairing roads; nevertheless, a mixture of sand and gravel should be examined for the riches and interesting objects it may contain: there may be Platina, Gold, Tin, Precious Stones, Agates, Jaspers, Amber, &c. Fossil remains, Fulgites, Osteocollas, &c., may also be met with.

Sandy and gravelly plains, i. e. such as are absolutely devoid of vegetation, exercise a powerful influence on the climate of a country by their siccity and repercussion of heat. It would be well if the traveller would always stick a thermometer in the sand, and by comparing its indication with that of another thermometer freely suspended in the shade at a given distance above the soil, note the difference, and endeavour to ascertain how far the colour, the nature, the size of the grains, &c., of the sand influence its own temperature, and that of the superambiant air. He will also do well, when sand is in the neighbourhood of water, as on the margin of lakes, rivers, &c., to dig and see how far the moisture penetrates by infiltration or capillary action, and if no water be visible near the spot to ascertain if water lies below the sand at a moderate depth.

Boulders and Erratic Blocks.—Gravel, as it increases in size, changes its name: and although it is difficult to define

the exact limit between coarse sand and fine gravel, large gravel and small boulders, large boulders and erratic blocks, still there is a common understanding on the subject, which prevents confusion.

Erratic blocks are of all sizes, from several cubic fathoms to the size of a human head. They do not form a soil of themselves, but are abundantly spread over all kinds of soil. To account for their existence is among the most difficult of the problems of speculative geology, and as furnishing matter for the compounders of systems, the traveller may, if he please, note, besides the extent of country covered with erratic blocks, which should always be stated, the following objects:—

What is the nature of the blocks? In what way are they scattered or collected? What is the distance and direction of similar rocks *in situ*, and the diminution or augmentation of size of the blocks, as they approach the places whence they may be supposed to have come? If they cover the land in slips or trains, what is the breadth and direction of these trains? When the blocks partake of an oval form, is it observable that their shorter diameters have all the same direction, and what is that direction as regards the true cardinal points of the heavens, and relatively to the direction of the trains? Are the blocks only superficially placed, or are they imbedded; in the first case, on what kind of rock or soil do they lie, and in the second, in what kind of soil and to what depth are they buried? Are all the blocks, in one place, of the same kind or of different kinds? What is the relative proportion and size of the different kinds compared to one another? Are the edges and angles of the whole very much rounded or the reverse, or is there a mixture of rounded and sharp angular stones? In the case of imbedded blocks and superficial blocks occurring together, do the former seem less rounded than the latter? Do the blocks lie along the bottom of a valley in the direction of its axis, or in a line across the valley, or on one or both sides, or collected into heaps in the re-entering angles of the valley; or are they on the hill sides high up? are they indiscriminately scattered in all places and directions, or in greater numbers on, or at the foot of, the height opposite the opening of a valley? Erratic blocks of a certain kind are sometimes found to be disintegrated in such a manner, that a slight blow is sufficient to reduce them to a coarse sand, in which the several ingredients are separated from

each other, though they all appear fresh and undecomposed. It would be interesting to notice whether the same kind of rocks is in all circumstances in the same state of disintegration, or whether it be observed in certain localities only; and if so, what are these localities, and do they furnish any clue to explain the phenomenon?

Boulders, when not too large, or in too great abundance, are, in some cases, advantageous to agriculture. Thus by sheltering hot and dry soils from the direct rays of the sun they keep them cool and moist: while their effect on cold soils is, by diminishing radiation at night, to maintain, a more equable warmth. Calcareous boulders are in some countries of great value from the absence of other limestone for cements. In many places the larger boulders of all kinds indiscriminately are used, with or without cement to form inclosures. In the north of Europe, the larger boulders or smaller erratic blocks are employed as foundations for the timber houses, which are by this means raised above the soil and preserved from rot. When blocks of fine porphery abound, manufactures are sometimes established for forming these into vases and other costly ornaments. Blocks of the hornblende rocks, when calcined and pulverized, form an excellent material for the composition of hydraulic mortar or water-cement, being little inferior to Puzzolana. Boulders and Erratic-blocks of certain size are also excellent for the formation of covered drains. Granite boulders are likewise employed as paving stones, and, when broken up, are excellent for the making and repairing of roads. Finally, the larger erratic blocks may be hewn and applied to all the purposes for which the same rock *in situ* would be quarried. We have enumerated these uses of Boulders and Erratic-blocks as particularly worthy the consideration of those travellers, whose business it is to examine the resources of any particular locality, with a view to the establishment of colonial towns or stations.

Proceeding downwards we find a succession of rocks known by the name of Tertiary rocks. Though the series of these, as found in some basins, is very analogous to the series of others, nevertheless it is occasionally very different; therefore, whenever the traveller finds himself in a Tertiary basin he will do well to describe the succession of the rocks and detail minutely the character of each. Our limits will not allow us to speak of each separate group of this epoch, groups which, according to Mr. Lyell, are four in number,

and are called by him, 1. the newer Pliocene, 2. the older Pliocene, 3. the Miocene, and 4. the Eocene. Of the Tertiary rocks, the most important in a technological point of view are the siliceous millstones, sandstone, gypsum, and the clays.

Siliceous Millstone.—This very useful mineral is divided into two kinds, the cellular and the compact; the former kind is reddish, and has its cavities filled with ferruginous clay. The compact variety has a straight and even fracture; its cavities are smaller and less numerous than in the former kind.

This rock is found in continuous and generally horizontal strata, seldom exceeding ten feet in thickness; it generally reposes on Potter's-clay, portions of which are found in its cavities; it is usually covered by ferruginous sand and rolled stones. The best kind of millstone should be of a bluish white colour, and pierced with numerous cavities. But the cellular variety, properly so called, is too soft and too tender for millstones, and is therefore employed as a building stone for basement stories, for which it is a very good material. The siliceous millstone contains no fossil remains.

Sandstones.—Though we have already spoken of these as forming part of the more modern formations, and though we mention them here as belonging to a group of the Tertiary rocks, they appertain also to the more ancient of the sedimentary formation, and are even, in some cases, regarded as a crystalline rock by certain naturalists.

There appears to be three distinct epochs of sandstone formation; the most ancient being the red sandstone; the next, the variegated sandstone; and the latest, the white sandstone, and its varieties. Not to repeat, however, we shall here speak of sandstones in general.

Examine them minutely, employing, if necessary, a magnifier. What is the nature of the grains, their size and colour, and the nature of the cement by which they are united? Generally, those sandstones whose cement is siliceous are the hardest, and those which are cemented by clay the most friable. Does the rock contain any fossils, and if so, of what kind? Are they whole and well preserved, or broken, or are they converted into silex, or totally destroyed, leaving only their impressions or the cavities they once filled.

Various minerals are found disseminated in sandstone, either in masses or layers, but seldom or never in veins.

These minerals are Garnets, Sulfurets of Iron, of Mercury, of Cobalt, of Copper, and of Lead. Whenever the sandstone contains any of these, the circumstance must be stated with all the particulars. Does the sandstone exist in one continuous bed, and if so, what is its extent? What rock does it repose upon; and what rests immediately upon it? Sometimes the sandstone is in large flat masses, forming an interrupted layer, and sometimes in great blocks irregularly imbedded in sand or marl. What differences are observable in the colour, constituent minerals, induration, &c., in different parts of the formation?

The uses of sandstone according to its particular nature, are very various, and when quarried, the traveller should observe how, in what quantity, and to what purpose the stone is applied. The sandstone of the different epochs are not always to be distinguished in hand specimens, but the geologist recognises them easily when they are *in situ*, by reason of the associated rocks, or the fossils they may contain.

Gypsum, or sulphate of lime, exists in quantity both in the tertiary rocks and in the underlying red sandstone group of the secondary period. It is also occasionally met with, though rarely, in primitive rocks, as in Mica-slate (Bellinzona in the Swiss Alps and a few other places). The Gypsum of the tertiary formation is sometimes found in the upper part of the series, as in the neighbourhood of Paris, and sometimes in the lower part, as at Weiliczka. The Upper Gypsum is particularly characterized by the presence of fossil bones of mammifera, birds, reptiles, and fish; it alternates with strata of Marl or with Adhesive-slate, containing those siliceous nodules known by the name of Menilites. This Gypsum often contains large crystals of Selenite; shells, vegetables, and insects are rare in it. The upper stratum of this formation is sometimes sixty feet thick. The lower Gypsum of the tertiary epoch is found together with rock salt, which is also, sometimes, the case with the Gypsum of the secondary rocks. This Gypsum is generally in the state of Selenite, though it is occasionally mixed with Compact Gypsum. It reposes on tertiary Limestone, and is more commonly found in masses than in regular strata: it is hardly to be distinguished from the Gypsum of the Cretaceous group but by its geognostic accompaniments.

The Secondary Gypsum, as we have said, forms, with or without rock salt, a member of the Red Sand-stone group, and is there associated with Variegated Marls.

The Gypsum of the Tertiary Period contains Fibrous Gypsum which is not met with in that of the secondary or primitive rocks. The Secondary, is disposed in strata, and sometimes contains imbedded minerals as Quartz, Aragonite, Boracite, and Sulphur ; the Primitive is mixed with Mica, which gives it a slaty texture that distinguishes it from the Gypsum of the other rocks. This kind is always white, and has the granulated texture of sugar ; it contains neither organic remains, nor marl, nor clay. The sulphate of lime exists in different forms. The lamellary variety receives a pretty good polish, but is easily scratched; it is employed for vases, urns, statues, and other ornamental objects. Fibrous Gypsum, from its fine play of light, is sometimes called Satin-spar, and is used in jewellery, for necklaces, snuff-boxes, &c. *Compact Gypsum*, looks very like saccaroid marble, from which, however, it is easily distinguished by its softness ; it is applied to the same uses as the lamellary variety : both of them are known by the name of Alabastrite or Gypseous Alabaster. Earthy Gypsum resembles chalk, and is an invaluable manure for grass and grain lands.

The common kind of Gypsum or Plaster-stone is often impure, and sometimes effervesces with acid, in consequence of a small proportion of intermixed carbonate of lime.

All the kinds may be used as plaster ; but an admixture of sand and clay gives the plaster a bad quality ; whereas a small proportion of Carbonate of lime is beneficial. Stucco is made from Gypsum. In short, its uses are various and important ; it is therefore a valuable mineral which must not be overlooked by the traveller.

Gypsum, though it sometimes lies deep, not unfrequently forms hills of considerable height and precipitous flanks. Gypsum hills, particularly of the Tertiary formation, have not unfrequently a peculiar aspect, by which they may be known at a distance ; they are long or conical, and are planted, as it were, upon other hills, lower and of larger base.

The above details are sufficient to point out that the traveller must observe the varieties of Gypsum, its grain and colour, and degree of purity ; its abundance, its stratification, or formation in masses ; the strata above and below it, or interposed ; the fossils or minerals which accompany it; the depth at which it is found, or if at the surface, the general aspect of the hills, &c.

Rock Salt.—This mineral is immediately recognised by its taste.

Salt is found either dissolved in sea-water or in lakes, or in springs ; imperceptibly disseminated throughout clay; in the state of efflorescence at the surface of the soil ; or in large imbedded crystalline masses, in which state iti s termed Rock-salt or Gem-salt.

Salt springs when they come to the surface may generally be recognised by the plants growing near them ; such as the *Triglochin Maritimum*, the *Salicornia*, the *Salsola Kali*, the *Aster Tripolium*, the *Glaux Maritima*, &c. Neither salt nor salt springs are known in the primitive rocks. Indeed salt springs are more frequently found in alluvial than in the older sedimentary formations. Nevertheless, rock-salt and salt springs are never at any great distance from primitive mountains ; they are usually found at the foot of these.

Rock-salt is usually in thick but uneven beds, sometimes in immense blocks : it is sometimes found superficially, more commonly at great depths, and is generally associated with gypsum in some form or other. Coloured clays or marls alternate with the salt, and are sometimes mixed up with it. The strata of clay are themselves preceded or associated with beds of sand, of sandstone, or gravel, and even of a compact brown bituminous fetid limestone.

Fossil mammifera, shells, and charred wood are occasionally found accompanying rock-salt ; but this we believe to be only the case with the salt of the tertiary rocks, none being found with the salt of the secondary strata ; at least there are no fossils in the salt formations of Vic and Dieuze.

Thick sedimentary beds of rock salt are sometimes found at the bottom of shallow salt lakes, or forming cakes where such lakes have once been and are now dried up.

The almost universal use of salt renders it an object of great importance ; nor must it on any occasion be overlooked by the traveller. Whenever he may find rock-salt he must state the situation in which it exists ; whether it be in beds or blocks ; the thickness and regularity or irregularity of the beds ; the size, and shape of the blocks, and the way in which they are disposed ; the nature of the under and overlying and alternate rocks, in the case of stratified rock-salt ; and the nature of the sand, clay, or marl, in which the salt, if it be in blocks, is imbedded. What is the colour

and degree of purity of the salt; and what are the minerals and fossils which accompany it?

When clay is observed to sparkle in the sun, the tongue should be applied to it, and if the spiculæ or little crystals be of salt it will be soon discovered.

When salt springs are met with, their situation must be exactly determined, as also the abundance of the spring; and whether it be constant or periodical; the degree of saturation of the water, and if it be the same at all times or the reverse; in the latter case at what season is the brine strongest?

If the Rock-salt be dug out, or if salt be prepared from the springs, the traveller should note the processes in either case, the number of persons employed, the annual quantity of salt obtained, its value on the spot and the profits. In the case of salt springs not worked, would it be advantageous to work them? taking into consideration the proximity of combustible, its kind, the facility or difficulty and expense of obtaining it in sufficient abundance.

Clay.—Clay is an object of such importance, by reason of the uses to which its different varieties are applied, that it is at all times deserving of the traveller's attention. We shall therefore say a word of the different kinds, the more particularly, as they are not only frequently confounded with each other, but with loams, marls, chalk, rotten-stone, tripoli, &c.

Clays are divided into two kinds, Infusible and Fusible. The infusible clays are 1st. Aluminite; 2d. Colyrite; 3d. Kaolin; 4th. Cimolite; 5th. Plastic clay; 6th. Lithomarge. The fusible clays are 1st. Fuller's earth; 2d. Figuline clay; 3d. Adhesive-slate; and 4th. Float Clay or mountain meal.

Aluminite, or pure clay, or native argile, is of a pure white, soft to the touch, and when examined with a magnifier, seems composed of a multitude of small, transparent, prismatic crystals; it adheres strongly to the tongue, but does not easily form a paste with water; when breathed upon, it emits an argillaceous smell, and it sometimes effervesces with acids. Aluminite is very rare.

Colyrite is white, and its tenacity is considerable; water may be passed through it by pressure, and it retains this liquid with so much force, that it requires a month to dry, even when reduced to small fragments. On drying it separates into prisms like starch; it then loses the half of its

weight and becomes very light. It is absolutely infusible, and is soluble in nitric acid without effervescence. It absorbs water with a hissing noise and becomes translucid, wholly or in part, according to the varieties, like certain hydrophanes.

Kaolin, or Porcelain-clay, is friable and meagre to the feel; when pure, it forms a paste with difficulty; it is absolutely infusible in the porcelain furnace, and acquires neither colour nor solidity; it merely hardens like other clays. The fine Kaolins are almost always of a beautiful white; some incline to yellowish or flesh red; many of the latter kind acquire in the furnace a greyish tinge which prevents their being employed in the making of fine porcelain. Kaolins almost always contain mica which points out their origin. This substance is found only in primitive mountains, where it exists in beds among the granite. Some Kaolins still retain the form of the felspar; they being in fact nothing more than a decomposition of that mineral.

Cimolite, (so called from Cimola, now Argentiera, a barren island of the Archipelago, whence the ancients obtained this species of clay,) is of a pearl white, and reddens a little by contact with the air; its texture is somewhat slaty; it is rather tender, soft to the feel, and has not unfrequently a greasy aspect. It adheres to the tongue with considerable force, whitens before the blowpipe, but remains infusible; it is often mixed with perceptible grains of quartz. This substance was used by the ancients for taking grease out of stuffs, as also in medicine; but it cannot be placed with Fuller's earth, having neither the unctuosity nor the other characteristics of that useful mineral.

Plastic-clay, or pipe-clap, is compact, almost greasy to the feel, and may even be polished with the fingers when dry; it forms a very tenacious paste: some varieties acquire in water a slight translucidity; it is infusible in the porcelain furnace, and acquires great solidity. This is a characteristic of the Plastic-clays, and distinguishes them from the Fusible-clays, which are also employed in the fabrication of the coarser kind of pottery. Of these clays some remain white or even become so in the fire, while others become of a deep red.

Lithomarge.—The colour of this argile varies from white to yellowish, to red, and to brown, and all the intermediate tints; it is sometimes striped and veined, and the veins are occasionally blue; its fracture is earthy and fine grained; it

is very tender, shines in the streak, adheres to the tongue, is greasy to the feel, rather light and easily frangible ; it is infusible before the blow-pipe ; it falls to powder in water but does not form a paste with it, which latter character distinguishes it from the Plastic and Figuline clays ; its strong adhesion to the tongue distinguishes it from Fuller's-earth. Lithomarge appears to belong to the primitive formations. It is found in lumps in Basalt and Amygdaloid rocks ; it forms veins in Porphyry, Gneiss, Serpentine, &c., and is met with in connexion with Tin, Mercury, Topazes, &c.

All the above-named clays are *infusible*, the *fusible* are—

Fuller's-earth.—This variety is greasy to the feel, may be polished with the nail, readily crumbles to pieces in water, forms a kind of pulpy mass, but does not acquire any great ductility ; it is rather compact, and adheres but slightly to the tongue. Several varieties of Fuller's-earth at first blacken in the fire, but are whitened by a stronger heat, which indicates the presence of some combustible matter. The yellow Fuller's-earth of Woburn, in England, melts at 120° of Wedgwood's Pyrometer, into a reddish brown pasty mass ; it exhibits no effervescence in nitric acid, but is instantly reduced to powder.

In order that a clay be proper for taking grease out of stuffs, its perfect mechanic dissolution in water must be prompt and easy ; a property which it has not when it is too unctuous ; the particles of silica, also, which it may contain, must be almost impalpably fine, otherwise they will wear holes into and injure the stuff. These qualities, and particularly its fineness, may be known by the degree of polish it is susceptible of taking when rubbed with the nail. Too great a quantity of iron, and particularly pyrites, materially injure its quality.

Figuline, or Potter's-clay.—The varieties of this kind of clay have almost all the external characters of the plastic clays ; many are, like them, soft to the feel, and make a pretty stiff paste with water ; but they are in general, less compact, more friable, and crumble more readily in water. Potter's-clay is of various colours, as bluish, greenish, gray, yellowish, brown, red, &c. ; but very rarely, if ever, white. All these colours are due to iron, so that instead of losing colour by the fire this kind of clay becomes of a bright red ; its fracture is uneven and never fissile though soft to the touch ; Potter's-clay has not the greasy feel of Fuller's-earth. Those varieties which effervesce with acids enter into the

class of Marls which character alone distinguishes them from Potter's-clay.

Potter's-clay, as its name indicates, is employed in the coarser kinds of culinary pottery, as also for chimney-pots, flower-pots, tiles, &c. ; objects made of it are red and porous, and vessels for cooking are accordingly coated with a glazing. Water-pots made of this clay are very good in hot countries, as an evaporation takes place from the surface which keeps the water cool.

The coarser kinds of Potter's-clay are used for brick-making ; an art of the utmost importance. It must be observed that though Potter's-clay, when pure, is infusible, yet it is generally mixed with such a quantity of iron, silica, and lime, that it would melt into a frit by the application of great heat. Ordinary bricks, however, not being subjected to such heat, the impurities mixed with the clay (with the exception of lime if in quantity), are of little consequence ; indeed the iron, by reason of the red colour it communicates is rather an advantage, and a certain proportion of silica is beneficial, as preventing the bricks from contracting too much and cracking ; but lime-stone in lumps must be carefully avoided, as, by the baking of the bricks, this lime-stone is converted into quick-lime which rapidly absorbs moisture, swells, and causes the bricks to fall to pieces.

Slaty-clay, or Adhesive-slate.—Its colour varies like that of all other clays ; but its remarkable texture is its chief characteristic. It is composed of plates or layers which separate with the greatest facility by the alternate action of moisture and dryness ; its laminar texture, however, is not always equally marked, and the laminæ are sometimes undulated and knobby ; which appears due to the siliceous nodules which it contains. In other respects it is like other clays, and is distinguished from slates, properly so called, by its forming a paste with water, which the latter never do.

Mountain-meal is remarkable for its lightness ; it floats on water so long as it is not penetrated by it ; it feels dry ; reduced to a very fine powder it is very hard, and is used with advantage in polishing silver. It has the qualities of what is termed Rotten-stone by workmen. It mixes up difficultly with water, and is by no means binding ; it is not fusible in the porcelain furnace, but it there acquires an extraordinary degree of hardness and contracts about 0.23. It does not effervesce with acids ; impressions of plants are

sometimes found in it. Fabrone manufactured floating bricks of it, and it has been recommended to line with such bricks the powder chambers of ships of war. This variety of clay approaches nearer to the nature of Tripoli than to that of true clay.

Of these various kinds of clay it may be observed that the Pure-clay, the Colyrite, the Cimolite, the Lithomarge, and the Adhesive-slate, are merely interesting as objects for the cabinet. The Mountain-meal is of some use, as we have said, for polishing; the Plastic, properly so called, and the Figuline or common clay, are generally both comprehended under the term Plastic or Potter's-clay. The former, that is the true Plastic or Pipe-clay, which is infusible, is of immense importance, as being used chiefly in the manufacture of those finer kinds of pottery called earthen-ware: the latter, which is fusible, is the common brick or tile-earth, and is also of most extensive and useful application. The Smectic or Fuller's-earth is invaluable in the preparation of woollen cloth, to deprive it of the grease; and Kaolin is most valuable as the chief material in the composition of china-ware.

The Pipe-clays and Potter's-clays are rare in primitive soils, unless it be in certain intermixed alluvial deposits. They are generally found forming hills along the confines of primitive chains, and in the middle of great calcareous basins. They do not, however, always form hills, but are sometimes disposed in thick beds. The clayey hills have generally rounded summits, and whenever clay is the surface soil it is remarkable for its sterility. It is observed that the clays which form hills have a schistose structure, and that they are harder, and dissolve in water less readily, than those clays which lie in interposed beds or masses. In the clayey hills fossil organic remains of both vegetables and animals are often found in pretty good preservation.

In the more recent and alluvial formations, the clays are found in extensive horizontal masses or beds, at a small depth below the surface, (seldom reaching 150 or 200 feet,) and generally covered with sand or gravel, &c.

The clays of alluvial formations often contain shells; the common Potter's or Brick-clays more so than the Pipe-clays and finer Plastics; they also contain iron-pyrites, crystals of Selenite; with pieces, and sometimes entire masses of Lignite.

The clays of the secondary limestone formation, and of alluvial deposits, are the most abundant and the most gene-

rally employed in the arts. Some of the Cimolites and Fuller's-earths seem to belong exclusively to Volcanic formations.

From the above details it is presumed, the traveller will not only be enabled to distinguish the different kinds of clay, but will see the kind of observations to be made on the useful varieties whenever he may meet with them; thus, whether it be Kaolin, Fuller's-earth, or Potter's-clay, he will note the spot, the ascertained or presumed extent of the mass and its qualities. If worked, he will note to what extent and for what purpose, and he will not forget to make a memorandum of anything which may strike him as new or advantageous in the several operations he may witness, either for extracting, preparing, or working the clays for the various purposes to which this interesting mineral is applied.

Marl is a mixture of clay with lime and sand in various proportions, and according as any one of the ingredients predominates over the others the marl is called argillaceous, calcareous, or sandy. Other substances are accidentally mixed up with the pure marls, as metallic oxides, particularly those of iron and copper, vegetable detritus, &c.

The use of marl is to improve land; different kinds of marl being suited to different kinds of soil. Marl is therefore a very valuable production, and should be noted by the traveller, stating the kind and the extent of the deposit.

Although some marls belong to the more modern formations, yet they do not always lie at the immediate surface. They are sometimes pretty deeply seated, and occasionally beneath a stratum of limestone rock. As a mineral, the exact composition of the marl, its colour, unctuosity, or friability, &c. should be stated; as also the position in which it lies as regards other strata. The fossils found in the marl must either be minutely described or specimens brought away.

Chalk, by its great abundance and the various uses to which it is applied in the arts, and which, to a certain degree, counterbalance the disadvantage of sterility, so remarkable where chalk forms the surface soil, is deserving of particular notice.

Chalk is a substance known to every one, but before a traveller asserts that he has seen beds of chalk in any place, he must assure himself of the fact, either by an examination of the substance itself, or by a consideration of those geolo-

gical associations which are sufficient to prevent chalk from being mistaken for Kaolin, white clays, marls, &c.

Chalk, when pure, is carbonate of lime unmixed with any other mineral, save, perhaps, a little magnesia and a little alumina. It is dull and earthy in the fracture, soft, light, meagre to the touch, easily scratched with the nail, and adheres slightly to the tongue; its colour is white or grey. It is, when pure, almost wholly soluble in nitric acid, with effervescence; but there generally remains a little undissolved portion, which is clay or magnesia. These characters, together with the associated rocks, distinguish it from Kaolin, which, as we have said, is found only in primitive formations; the entire dissolution of chalk in nitric-acid distinguishes it from white clays, which are insoluble, and from marls, which contain a great quantity of clay.

Though white is the common colour of chalk, it is sometimes traversed by coloured streaks, occasioned by iron. There is also a red chalk, which must not be confounded with ochre, which is a clay coloured by iron. We have also said that chalk is tender; there are varieties, however, which are sufficiently hard to be used as building stones, as is the case in Normandy and elsewhere. The town of Dongola, on the Nile, is constructed of a chalk of this kind. Some kinds of chalk are even semi-crystalline, and may be cut and polished; but in this case they can no longer, with strict propriety, be regarded as chalk. They are then a white limestone or marble. The geological situation alone ranks them as chalk.

Chalk contains no metals except Iron-pyrites, which are generally globular; but usually it abounds in flints, particularly in the upper parts, though they are sometimes also found plentifully in the lower parts. That species of silex known by the name of Cachalong is also occasionally found in chalk, and marine fossils are abundant in this sedimentary formation.

Chalk is used in the arts as a material for drawing and painting, and, when mixed with vegetable colour not containing any acid, such as litmus, turmeric, saffron, sap-green, &c. it forms excellent pastels or crayons; it is also employed for cleaning metals and glass. When washed, so as to purify it wholly from sand, and made into cakes, it is known as Spanish white. When burnt, it forms a lime equal, according to Smeaton, to that obtained from the best limestone or marble; little else is used in London. Chalk

is also employed for the formation of moulds in founderies. Starch makers use it for drying their precipitates; with fish-glue or white of eggs, it forms an excellent lute; gilders on wood cover picture frames, &c. with a coating of it, previous to laying on the gold; and it is sometimes used as a filtering-stone; in medicine it is employed to correct acidity in the stomach. These various uses of chalk are mentioned merely to convince the traveller, that this mineral is of more importance than he might at first imagine. He will, therefore, be careful to notice it wherever he may meet with it; and if it is worked, he will not fail to mention the number of persons employed, and to describe the methods of extraction, the uses to which it is employed, and the profits derived from this kind of industry.

Chalk, which covers immense districts, and lies in beds of great thickness, usually presents itself in the form of plateaux with vertical edges, or as rather high and rounded hills. Chalky countries, according to an observation of Brongniart have, in general, neither caverns nor water-courses, (springs?) and, unless when covered with a stratum of loam and vegetable earth, are absolutely barren: a familiar instance of which is, that part of France called *la Champagne pouilleuse.*

In a geological point of view, the traveller should ascertain the extent of the chalk and the thickness of the bed, as also the height to which the chalk hills rise, excluding any overlying rock. What beds may be interposed between the chalk, as marl, strata of flint, &c.? What are the fossils and their relative abundance? What rock does the chalk immediately rest upon, and what rests immediately upon the chalk? Is there any difference between the upper and lower parts of the bed of chalk, and what is that difference, &c.?

Limestone and Marble.—Limestone is one of the most abundant substances of the mineral kingdom; it appears to have been formed at a variety of epochs, and under various circumstances. It is found forming extensive mountain chains, and thick beds both in the tertiary and secondary rocks. It is always stratified, is sometimes without fossils, sometimes thickly studded with them, and sometimes almost wholly composed of them. The fossils are sometimes those of fresh water, sometimes marine, and sometimes a mixture of both in various proportions. The colour and texture of limestone is very various, and its purity more or less perfect.

There is a graduated passage from the most pulverulent chalk through limestone of various qualities, to the hardest and most beautiful statuary marble.

The purest variety of carbonate of lime is that which is crystallized and transparent, the finest example of which is the well-known Iceland Spar, particularly remarkable for its doubly refracting property, so easily observed. The secondary forms of calcareous spar are exceedingly multiplied and highly interesting to the crystalographer. The curious traveller will do well to collect fine crystallizations of lime, as they are desirable in cabinets: they are found in metallic veins, and in the fissures and cavities of calcareous rocks. There is a laminary or confusedly crystallized variety of carbonate of lime occasionally found in masses, but more commonly in veins and fissures in marble and common limestone.

Saccharoid or saline marble, so called from its brilliant granulated texture, might be confounded with Magnesian limestone, were it not that the former effervesces easily and briskly with acids, which the latter does not. The Saccharoide and lamellary marbles are very similar, and sometimes pass into one another.

The earthy textured coloured marbles and compact limestones come next, including Lumachellis and calcareous Breccias.

Oolites present the singular appearance of a texture formed of small rounded grains from the size of a poppy seed to that of a small pea. The oolites differ from the globular concretionary limestone in this, that the grains of the former when broken, exhibit neither a radiated texture, nor concentric layers.

Common limestone is of a loose texture, of a dull and earthy fracture, generally coarse grained, but sometimes fine grained, though soft.

These several varieties of carbonate of lime, are subdivided into a great number of sub-varieties, all more or less interesting to the mineralogist, and worthy of being collected as cabinet specimens.

The various uses to which the several kinds of limestone are put, are too well known to need detailed description.

The object of the traveller in his consideration of calcareous as of other rocks, is twofold; 1st, to observe and describe to the best of his ability the geognostic character and geological relations of the rocks; and, 2ndly, to ascer-

tain the kinds and abundance of the useful varieties. Thus whenever he meets with limestone he will examine it carefully, describing its colour, fracture, grain, and degree of hardness, the thickness of the strata and their position, the contiguous rocks below and above, or interposed, and, if the limestone forms hills, the height and extent of these. The absence or presence of fossils, and, if any exist, their nature, their position, and relative abundance ; are any minerals, and what, associated with the calcareous rock? If the rock be quarried, the traveller should note the number of men employed, the extent of the works, the purposes to which the stone is applied, and the profits arising from this industry. As the traveller in countries yet new and unsettled should draw attention to its unemployed treasures, he must understand the peculiar property of the different kinds of calcareous rocks for specific purposes before he can recommend them for such. The white lamellary, or the fine close grained saccharoid marbles are peculiarly valuable for the statuary. The more particularly as most of the ancient statuary marbles are lost, and fine modern statuary marble is rare. The white, of less beautiful texture, or the white with greyish or greenish veins, is employed for columns, vases, tables, chimney pieces, &c., for all which objects the coloured opaque marbles are also admirably suited. When marble is but of one colour, that colour should be pure and without mixture; when the marble is of different colours, these should be bright and contrasting, and whether in veins, or spots, or patches, these, to constitute a beautiful marble, must be arranged in a manner agreeable to the eye. The susceptibility of taking a fine polish, is essential to all kinds of marble.

Compact limestone is perhaps of all building stones the best; but before a traveller pronounces that there exists in any place an abundant supply of fine calcareous building stone, he must attend to the following particulars:—The durability of the stone is best judged of by observing the condition of those parts which have been long exposed to the elements. A good building of stone must be sonorous under the hammer, close grained, and of even texture; it must work with facility and in various directions without splitting, and yet be sufficiently compact not to absorb water, which, when a frost may come, will split it. It must be tenacious, so as not to be crushed by the weight it will have to bear. Most limestones must be placed in a building in the same

way they lay in the quarry; but some kinds may be placed in any direction; these are particularly valuable for columns, lintels, &c. Some stones that are so soft when first extracted as to be cut with a common toothed saw, become very hard by exposure to the air; others again that are hard in the quarry quickly disintegrate when exposed. Thus some stones are exclusively applicable to internal construction and foundations, and others are applicable equally to internal and external parts. Some are good for common walls only, in consequence of the natural fissures of the strata, and others are good for large steps, slabs, soffits, &c.

The common coarse grained limestone may be employed for obtaining quick lime for mortars, though inapplicable to other purposes; but it must not be hence inferred that the kinds of calcareous rock already mentioned will not furnish good lime; on the contrary, the finest marble is by many supposed to produce the best lime.

There are three particular kinds of lime. One absorbs a great deal of water, swells exceedingly, and admits a great admixture of sand; it is generally very white; it does not harden under water, and therefore must not be employed under ground, in foundations, or in water. The next kind swells but little, absorbs but little water, admits but a small proportion of sand, quickly hardens when exposed to the air, and acquires a slight degree of hardness under water, it is seldom very white. The third kind, or hydraulic lime, hardens under water without addition, it is seldom white, but is the very best kind; it contains naturally an admixture of clay.

There are no certain indications by which the traveller can judge *a priori* of the kind of lime that any limestone will furnish, but a very simple experiment will give him valuable information on this head, and we therefore recommend it to him. It is from Brard. Calcine a piece of the limestone and throw it into a small vase of water, observe if it absorbs much or little. After a few days, observe if it be set and hard, or if it remains soft, remark also the colour, which, if very white, renders it proper for whitewashing; this kind of experiment is preferable to chemical analysis.

Lithographic Stones.—Among the varieties of limestone is one to which modern discovery has given particular value; it is compact, close grained, of a yellowish or brownish white tinge, and susceptible of a good polish. The spotted varieties are not good, because in such the texture is

not homogeneous. Good lithographic stones are not common, and the traveller should not fail to notice them whereever he may find them.

COAL.—Such is the immense importance of this valuable combustible that we think it necessary to enter into greater details regarding it than we have done for other minerals. We shall first describe its general characters, then the specific characters of its varieties, the formation in which it is found, the methods of seeking for it, &c.

General characters.—Coal is almost a perfect black colour and generally shining; it is not hard, it is generally brittle, but never soft enough to be scratched with the nail; its mean specific gravity is 1·3.

It burns easily, with a white flame and black smoke, giving out a particular bituminous and in some cases sulphurous smell; it leaves after burning, a cinder, sometimes very voluminous, being about 3 per cent, but it sometimes leaves nothing but a white ash in small quantity. Coal cinders are hardly ever pulverulent, they are generally in the form of a light scoria, or of a dust mixed with scoriæ.

This combustible by distillation gives out an empyreumatic oil, ammoniacal gas, and sometimes sulphurous acid gas without ammonia.

Coal has never been found crystallized; it is always in mass having sometimes a slaty texture, and often a conchoidal though more generally a straight fracture; in the latter case the mass generally divides in parallelopipedons of considerable regularity; finally, in some varieties the surface of the fragments exhibits the most beautiful and varied colours.

Such are the chief characteristics common to the different varieties of coal, and which serve to distinguish it from all other combustibles; the facility with which it burns and the smoke it gives out, distinguish it from Anthracite; its solidity prevents its being confounded with Asphaltum, which may be cut with the nail, and which gives out, when rubbed between the fingers, a very sensible bituminous odour; finally Lignite, which very much resembles coal, gives out by distillation an acid and empyreumatic liquor. The varieties of coal differ so slightly from each other, and their points of resemblance are so numerous, that it is very difficult to determine them with precision. However as these varieties have different uses in the arts, it is desirable to know at least, the principal of them.

Werner establishes six different varieties. We however prefer the classification of Mons. Brogniart, who recognises only three well distinguished varieties.

Compact Coal.—This variety is of a greyish black and without lustre, its fracture is sometimes largely conchoidal, and sometimes straight with an even surface ; it is solid without being hard, and though compact is very light. Its specific gravity according to Kirwan is 1·23 ; it is easily cut and takes a good polish. It burns well, with a brilliant flame, gives out but little heat, and leaves hardly any residuum. This coal very much resembles Jet, only it does not give out in burning the same penetrating and disagreeable smell that proceeds from Jet. Vases and other ornaments are made of this kind of coal.

Fat Coal, is light, brittle, very combustible, and burns with a long white flame. It swells and seems to enter into a kind of fusion, while it runs together or cakes. It leaves little residue and yields by distillation, bitumen and ammonia. This kind is found along with slate, but has never been seen in calcareous rocks. It sometimes contains marine fossils.

Dry Coal.—This kind of coal is both heavier and more compact than the first kind ; it is sometimes less intensely black, approaching to iron grey, it burns with difficulty, and without swelling or caking, and leaves a greater residue. There is scarcely any flame from it, and what there is, is bluish. By distillation it gives out neither ammonia nor bitumen, but sulphurous acid only. All the coal found along with compact limestone belongs to this variety. The slates which cover this variety contain rather impressions of ferns than of grasses.

Geognostic character.—Coal is always found in mass, sometimes in heaps, but generally in strata and very rarely in veins. The strata are variously inclined, dipping slightly and being contorted in every possible way.

Coal is almost every where accompanied by the same kind of rocks, the knowledge of which is essential, whenever we would seek for this valuable mineral, in order to avoid attempts often useless, and always expensive. Coal is never found in primitive rocks nor among those of the more recent formations, as coarse limestone, chalk, sand, white and homogeneous sandstone, &c. Some combustible minerals are found in these rocks, but they must not be confounded with coal.

1st Formation.—The coal-fields, as they are called, vary little. Among the rocks of which they are composed, we generally find in the following order: 1, micacious and ferruginous sandstone, often very coarse grained. These sandstones are not exclusively composed of quartz and mica, but contain fragments of stone of all kinds, particularly felspar; 2, clay-slates and mica-slates with impressions of fish and of vegetables belonging generally to the ferns and grasses; 3, strata of marl, of limestone, or of indurated clay; 4, a kind of secondary argillaceous rock containing petrified branches, roots, and even whole trees; 5, argillaceous iron-ore; 6, pebbles in a ferruginous sand.

The coal of this formation is in strata alternating with strata of the rocks just mentioned, and which are indistinctly above and below the coal strata or seams; it appears, however, that the coal is never found in the bed of pebbles, and that in general the contiguous rock both above and below the coal is slate; but that below the coal often differs from that which is above it, and what appears singular, it has been observed that the overlaying slate is impregnated with bitumen while the underlying contains none. Such, then, is the way in which coal, at least the best qualities of this combustible, are found: it nevertheless exists in two other kinds of formation.

2nd Formation.—This is a series of trap-rocks in which the coal is found in very thick and extensive beds. The varieties usually met with in this repository are pitch coal, moor coal, coal blend, or blind coal, and sometimes slaty coal. See Millar, p. 244.

3rd Formation.—This consists of compact limestone in thick and almost horizontal strata, in which are found powerful beds of coal. This limestone often contains fossil shells, and although the limestone be black by reason of the bitumen with which it is penetrated in the immediate vicinity of the coal, the shells retain a brilliant whiteness, which, by the contrast produces a very agreeable effect. Coal has been met with in veins of eight yards thick in sandstone.

The repositories of coal are generally found midway between primitive and secondary mountains. Coal mines are rarely found in the centre of the primitive mountains themselves; when they are, it may be remarked that they rest against the slopes of these mountains at great heights. Coal mines are also rare in plains at a great distance from mountain chains; and when they do exist in such places, the coal

is situated at a great depth, always in the slate-rocks and below the limestone.

The strata of coal generally follow the direction of the valley on the flanks of which they are situated.

Coal sometimes contains metals; thus oxide of copper, sulphuret of mercury, native silver, gold, sulphuret of lead, or galena, and antimony, have been found in it. Iron ore is a frequent and most valuable accompaniment of coal.

The coal of which we have spoken hitherto is the black coal, or coal properly so called. There are, however, varieties of what is termed Brown-coal and Lignite which occur in alluvial formations and are comparatively superficial. The Brown-coal is generally accompanied by clay and gravel, the coal-beds do not preserve an equal thickness throughout their whole extent. The coal-seams of alluvial land are not interrupted by slips and dykes, as is the case with the coal strata in other soils.

Uses of Coal.—As the applications of coal are different, and as the different kinds are more or less perfectly appropriated to different purposes, it would perhaps be well to speak of these; for the value of a coal mine depends on the circumstances under which the combustible may be usefully employed.

Its first use is for domestic fuel. Coals for this purpose should burn easily with a clear flame, and give out no disagreeable odour. For convenient use the fragments should be of middling size; if too large they are easily broken, but great fineness is very inconvenient. The smallest coal, however, may still be used by adopting the plan followed in Belgium and elsewhere: this consists in dissolving a certain quantity of clay in water, this is thrown upon coal-dust, and the whole well mixed; the mass is then formed into balls, or moulded into bricks: these burn well but slowly.

The second use of coal is for the forge, and for this purpose the coal must be fat and light, and must, in burning, swell and cake; by this means it forms a dome or cupola over the iron, which keeps off the external air and concentrates the heat. Provided the proper kind of coal be employed, the size of the fragments is immaterial, indeed it is best when fine, for, being wetted, it may be laid on, how, and where wanted, and cakes readily.

Coal intended for furnaces, particularly reverberatory furnaces, must be in large lumps and must burn with flame. Several varieties of coal may be employed for this purpose,

but according to their particular nature they give out more or less heat.

Coal, nevertheless, cannot be employed in a natural state in every one of the purposes of art and of metallurgy. It is purified from the noxious ingredients with which it is mixed by conversion into *coke.* As in countries where coke is used, the methods of preparing it are different, the traveller will do well to make his observations on this subject.

Besides the uses to which we have already alluded, it may be observed that coal is advantageously employed in the baking of fine earthenware ; but neither coal nor coke can be used for the baking of porcelain. Coal is used in glass furnaces, &c. We cannot in this enumeration, rapid as it is, omit to mention the extensive application of coal to the purposes of illumination. This is effected by the distillation of the coal, by which its combustible gases are given out, purified, and collected for use.

That particular kind of coal which is known by the name of *jet,* is much employed, particularly for mourning ornaments, as necklaces, rings, &c. In the single district of Aude in France, twelve hundred persons are employed in making different articles from Jet ; the annual quantity of this mineral so applied amounting to a thousand hundredweight. Spain alone consumes 18,000 livres worth of these articles. The net profit of the whole is 35,000 francs.*

Of the quality of coal in general it may be remarked, that it is so much the stronger and better as it contains more carbon and less ash. The quantity of ash is ascertained by complete burning of the coal. Kirwan says the quantity of carbon may be ascertained by deflagrating the coal with nitre, which burns the carbon without acting on the bitumen.

Seeking for Coal.—When the traveller suspects from the geognostic composition of the country that coal may be found, he must examine every place likely to present him with a section of the soil. There it is that he must determine whether the rocks are such as usually accompany coal. He may, it is true, find rocks resembling those of some of the coal formations without there being any coal ; but, whenever, on the other hand, he finds a soft bluish slate containing nodules of argillaceous iron stone, or a gray stratified rock, containing, disseminated in its mass or between its layers, a small quantity of coal, he may be almost assured that

* Journal des mines.

he is in the vicinity of a coalfield. If, in a section of sandstone rocks, he finds strata of a black carbonaceous substance interposed between the beds of sandstone, or small disseminated fragments of coal in the rock itself, these are favourable indications; but as it is impossible for him to judge, from these appearances, at what distance he may be from a stratum of coal worthy of being worked he must urge his researches further.

The strata of coal, as well as those of the accompanying rocks, generally crop out somewhere; but as coal is tender, its out-croppings are not so easily recognised as those of other mineral substances; for they are rubbed, worn down, carried away, mixed up with the vegetable mould, or covered by sand, &c., and thus concealed. The out-croppings, however, are often discovered after rains have washed away the soil which hid them, or they are laid open in digging trenches, &c. In general, grains of coal are first observed mixed with the soil; even the plough often leads to discovery, by turning up small pieces of coal, or a black substance resembling soot. In such cases, if the soil be dug, large pieces of coal will generally be found.

Whenever, in consequence of such indications, the traveller would discover the stratum of coal whose proximity they indicate, he must first ascertain the general inclination and direction of the strata which form the soil of the country, otherwise, the indications will soon be lost sight of, and, consequently, the erroneous conclusion will be formed that there is no coal.

The symptoms of coal often extend a great way beyond the out-cropping of the stratum, on a level surface; but when the soil is inclined they extend of course much further. It must also be remarked, that the out-cropping of even a very thin bed of coal, is sufficient to cover a great extent of surface with its débris.

The further the débris are removed from the stratum the smaller they are, and the nearer you approach the bed the larger the fragments become, and the more perfectly characterized. When the out-crop is on an inclined plane the vestiges will always be found lower than the out-cropping; and the greater the slope, the farther removed will be the débris.

When the stratum of coal comes up on a horizontal surface, the vestiges may be on both sides: it is therefore necessary, previous to trenching, to know in what direction the beds of the country incline. Thus if the dip be to the

East, the searcher should sink a pit to the eastward of the centre of the indications, when he will rarely fail to come upon the bed at no great depth. If the dip of the strata be not known, then a trench should be dug right across the line of indications, i. e. perpendicularly to the out-cropping; and this trench must be sunk till the true stratum be found.

If the out-cropping be on an inclined surface it will surely be found higher up than the spot where the indications are met with. The trench in such case must be dug upward from the place where the débris are found.

When a bed of coal traverses a ravine, indications of it will probably be found in the bed of the stream or on its banks. Generally, if the coal crop out in a direction parallel to that of the ravine, the vestiges will be found extending in the same direction; whereas, if the stratum traverse the ravine, the indications will also cross it.

If the indications are not sufficiently extensive to enable you to judge of the direction, i. e., the strike of the stratum, you must seek in the environs in order to discover if the stratification is in a direction parallel to the ravine, or if it cross it either perpendicularly or diagonally, and then proceed to the search by pit or trench according to circumstances.

It must, however, be remarked that in coal countries, fragments of coal are often found without being indications of the immediate proximity of this combustible, as is the case when the débris of coal are found in alluvial deposits, as sand, gravel, clay, &c. It is in such case particularly that the necessity of knowing the general geology of the place is felt, in order not to confound this transported soil with the natural soil of the country: for, without this knowledge, researches might be made as fruitless as they are expensive. In such case, search must first be made for the place whence the transported soil has been brought, and that found, one of the methods already indicated may be employed with hope of success.

Another circumstance which may lead into error those who do not understand these matters is, that in countries where coal is used, a certain quantity of small pieces of coal may be thrown upon the soil with the ashes and dung. The mixture of ashes, however, will be a sufficient hint in this case.

Of all the substances which may cover and conceal a bed of coal, the most common is, a kind of indurated clay,

very hard and tenacious, and more or less mixed with sand, gravel, and stones. This mixture is almost as hard as a rock. It is sometimes formed of the débris of all the neighbouring rocks, and is sometimes from thirty to forty yards thick; it contains a great quantity of pieces of coal, so that it is often difficult to know whether it is transported coal, or the indications of an outcrop. In this case, some attempts may be made by sinking in the clay. If, in doing this, the appearances do not change, it may be concluded that the carbonaceous clay is an alluvial deposit; nevertheless it is an indication of the neighbourhood of coal. It must further be observed that transported débris of coal are generally in pieces of a certain size and with sharp angles, whereas the coal of an outcrop is commonly in a state of decomposition more or less complete, unless it be of the compact or slaty kind, which is capable of supporting friction and the effects of the elements without alteration. Be it remembered always that no judgment can be formed of the thickness of the bed or of the quality of the coal until it be seen between *roof* and *pavement.*

Such then are the necessary notions in regard to coal. If no coal mines are known in the country, but there be reason to believe, nevertheless, that coal exists, it may be sought for by the means already described; but if coal mines already exist, they should be observed in detail, noting the names they bear, and the places where they exist; their depth, the order of succession, the thickness, and the nature of the different strata composing the formation; the quantity of coal annually produced; its value; the expense of extraction, and the net profit. What are the fabrics and manufactories which they chiefly supply, &c.? After describing each separate coal mine, a general recapitulation of all the coal mines of the country should be made. State whether the mines are in a flourishing condition or are neglected; and if the latter, what are the causes and the consequences; as also what might be done to increase their importance.

Ironstone.—This argillaceous iron-ore, has a dull and often earthy fracture; it is rather soft than hard to the feel; it adheres to the tongue, does not effervesce with acids, and blackens before the blowpipe without melting. Its principal colours are a reddish or yellowish clay, and sometimes a brick-colour. When the colour is a bluish grey, it is changed to brown by nitric acid.

The most common kind is generally found in mass, sometimes containing vegetable impressions. It is found in layers or beds in secondary formations composed of argillaceous and bituminous schistus. It is sometimes accompanied by Ochry-brown-iron-ore, Carbonate of Zinc, Sulphuret of Iron, Sulphuret of Lead, &c., as also by Sulphate of Lime. In many places it is found in the form of flattened spheroids, as big as the head or bigger; the spheroids are sometimes compact and sometimes traversed by veins of Quartz; sometimes they present concentric layers alternately brown and compact, and yellow and friable. The greatest quantity of what is used in Great Britain is found in the coal formations.

Wacké or Wacken is a stone of such undecided appearance as to require some details: we shall adopt the description given of it by Mons. Brogniart. Its fracture is dull, and even sometimes conchoidal, sometimes uneven and fine grained; it is somewhat soft to the touch, rather tender, and very easily frangible. It is very fusible before the blowpipe; generally attracts the magnetic needle, and does not adhere to the tongue. Its specific gravity is from 2·53 to 2·89.

Its ordinary colours are a dark greyish green, a blackish green, and grey, sometimes brown or reddish.

It is distinguished from hard clays by not forming a paste with water, by its possessing a more compact and homogeneous texture, and by its fusibility; it differs from marl in not effervescing with acids, and from hornstone by its easy frangibility, &c.

This rock is more subject to decomposition than basalt; it forms part of the secondary, or, according to some arrangements, transition rocks: it appears to belong to basaltic formations, and is found sometimes in strata, and sometimes in veins in the trapp rocks. These veins are of very recent formation as compared with metallic veins, as they always traverse the latter, and hardly ever themselves contain metallic ores.

Wacké is generally the foundation of the amygdaloid rocks, and contains in its cavities green earth, Carbonate of Lime, Zeolite, Agates, &c. Some of the mineral substances found in Wacké seem to have been enveloped by the rock when in a pasty state; and others seem to have been subsequently formed in its cavities; of the first kind are Basaltic-Hornblende, Native Bismuth, Magnetic Iron, and black shining Mica. The latter is so generally found in Wacké that in some cases it may serve to make it known;

it is in rather large plates, and at some distance from each other. Sometimes petrified wood and fossil bones are found in Wacké.

In Geology the name *Grauwacké* has been given to a whole system of Schistose rocks, of various characters, and composed of different substances.

Grauwacké, says a writer who had much practical knowledge, "is divided into Common Grauwacké and Schistose Grauwacké."

Common Grauwacké is composed of grains or pieces of quartz, siliceous and argillaceous schistus, cemented by a substance of an argillaceous nature. The grains are sometimes very small, and sometimes of the size of a nut, or even larger.

Schistose Grauwacké is a simple rock of a slaty structure, which, in its composition and texture, is nearly allied to argillaceous schistus; but it is essentially different from that rock in its position, which is always connected with Common Grauwacké, and because it is never interrupted, like argillaceous schistus, with beds of Chlorite Schistus. It contains besides, no grains of Quartz, Schorl, Felspar, or Garnet, but is mixed with Mica in small scales. It is nearly of a bluish or greenish colour, but most commonly of a dirty grey. Schistose Grauwacké forms beds which alternate with those of the first variety.

Grauwacké-rocks are traversed by veins of Quartz in different directions. They contain sometimes remains of shells and impressions of reeds. These rocks are distinctly stratified; but the direction of the strata is not parallel to those of the other rocks on which they rest. This rock is rich in metallic ores, as in the Hartz where there are extensive veins of lead and silver in Grauwacké. In Transylvania the same kind of rock is remarkable for rich ores of gold, &c.

Trapp.—The transition trapp of Werner is composed of Hornblende and Felspar so intimately mixed that the mass appears homogeneous. It very much resembles certain Basalts, and sometimes is like a very fine Wacké. It gives out an argillaceous smell when breathed upon. It has a tendency to split into rhomboidal fragments, &c.; but the name Trapp has been given to so many stones essentially different, but very similar in external characters, that it is difficult to say precisely what is trapp.

Under the general name of secondary trapps have been ranged, besides the trapp just mentioned, Wacké, Basalt, Basaltic Tufas, a kind of Amygdaloid, Whinstone, &c.

Siliceous Schistus.—This stone is sometimes found in immense masses, and may be classed among the rocks. It has been called a schistose jasper, and is thus characterised. It is generally fissile, its colour varies from grey to black, it is very hard and absolutely infusible ; its fracture is straight or slightly conchoidal. Its slaty texture is not always apparent in small specimens.

This rock presents a character which does not belong to its nature, but which is rarely wanting ; it is almost always traversed by veins of white quartz.

Quartz rarely forms of itself entire mountains, but it is found in strata of great thickness in Gniess, &c. In the north of Scotland Quartz-rock of a granular texture, forms considerably high mountains, and in the islands of Isla and Jura it constitutes the base on which the greater part of the rocks of these islands repose.

This stone has been placed among rocks by some, while others consider even the largest masses of it as parts of veins of great thickness. Macculloch thinks the Quartz-rock and Vein-quartz quite different.

Quartz-rock is of a compact though granular texture, very tough and hard : its fracture is uneven, often wavy so as to be at the same time uneven, yet soft to the feel ; it has no cleavage, but in breaking seems to affect a kind of pseudo-regular form. Its colours are white or greyish, when not soiled by the presence of iron.

When this rock contains disseminated mica which is often the case, it bears the names of Hyalomicte, Greisen. In the case of the Itacolumite, or flexible sandstone of Brazil, it has all the appearance of a Micaceous Sandstone.

Topaz-Rock.—Topazes are found in different kinds of rock ; but the rock which bears particularly the above name has hitherto been found only, we believe, at Schneckenstein in Saxony. It is composed of Quartz, Schorl, Topaz, and Lithomarge. These substances are in very fine grains, but are disposed in thin strata. It reposes on granite.

The rarity of this rock renders it a desideratum for travellers to discover it in some other locality.

Greenstone or Whinstone is composed of hornblende and felspar ; it differs from Syenite in as much as it contains no quartz, and the hornblende is more abundant. Certain varieties approach to Hornstone, and with Schistose Greenstone, &c., form part of the rocks called generally Trapp rocks.

Schistose Greenstone differs only by the arrangement of the particles of hornblende, which lie in little scales, like mica, and give the rock a slaty structure. Greenstone is a good building-stone. When heated to redness and plunged into cold water, it may then be pulverized, and forms a good substitute for puzzolana in the preparation of hydraulic cements.

Syenite is essentially composed of Felspar and Hornblende with a portion of Quartz: Felspar is the predominating mineral. This rock is sometimes coarse-grained, and sometimes fine-grained ; it is occasionally very fine. When the rock contains crystals of Felspar it is called a *Syenitic Porphyry*, or more correctly perhaps, a *Porphyritic Syenite.*

This rock is very rarely stratified, but it sometimes contains metallic veins ; its name is derived from Syene, in Upper Egypt. This stone was much esteemed by the ancients, who employed it very much in their architecture ; it takes a fine polish when its grain is fine.

Serpentine is compact, its fracture is dull, earthy, rather straight, but uneven, and sometimes scaly. It is soft to the feel, and its powder is unctuous. It is hard enough not to be scratched with the nail, and even itself to scratch Carbonate of Lime. This hardness is almost the only character which distinguishes it from common Steatite.

The colour of Serpentine is sometimes uniform, sometimes arranged in veins, patches, &c. ; it is most generally of a leek green or some shade of this. There are, nevertheless, both reddish and yellowish Serpentines. Serpentine hardens before the blowpipes, sometimes scorifies, but does not melt. Its specific gravity varies from 2.57 to 2.70.

It is easy to see, by these vague characteristics, that in certain cases it is hard to distinguish Serpentine from Steatite, and from Chlorite Slate.

Noble or Precious Serpentine is employed for making snuff-boxes, vases, and other ornamental objects ; as is also Common Serpentine. Of the latter kind particularly, culinary vessels are made. Serpentine, as it powerfully resists the action of fire, is also employed as a firestone in smelting furnaces.

Where this rock is primitive, it is found in connexion with Saccharoid Marble, Gneiss and Mica-slate ; but it is seldom met with at very great elevations. This rock contains scarcely any metallic veins, but it is of itself sufficiently valuable to be attended to.

Porphyry.—This rock is known by its being composed of a base or mass in which are imbedded crystals, or rhomboidal fragments of Felspar, or grains of Quartz, Porphyries are distinguished by the nature of their base, which may either be Compact Felspar, Hornstone, Pitchstone, Indurated Clay, &c. Thus when crystals of Felspar are found in Syenite, in Hornblende rock, &c., these stones take the name of Syenitic-porphyry, Greenstone-porphyry, &c.

It was thought that, with the exception of Clinkstone, porphyry was not stratified ; but according to Humboldt, Trachites are very regularly stratified in the Andes.

Porphyries do not abound in metallic veins ; they nevertheless sometimes contain them ; the mines of Schemnitz in Hungary are in an argillaceous porphyry.

Porphyries have ever been, and still are, greatly esteemed for columns, vases, &c. : the more the mass is homogeneous, hard and compact, the more distinct the crystals that are imbedded, and the greater the contrast between the colour of the crystals and that of the paste or base of the stone, so much the more is the porphyry prized. This stone is susceptible of a very fine polish, is very hard, and consequently the objects made of it are very expensive.

Hornblende Rock.—This rock which approaches to Wacké on the one hand, and to Clay-slate on the other, is not easy to determine. It seems in some cases to pass into greenstone, but real greenstone never changes its character in the vague and undefined way, common to what is usually termed Hornblende rock. Those who take what might by some be regarded only as a particular kind of hornblende rock as a type thus describe it :—

This stone is generally compact and solid ; its fracture is dull, somewhat smooth, but irregular ; when breathed upon it emits a very sensible argillaceous odour ; it is very difficult to break, the hammer rebounds from it, and this kind of tenacity distinguishes it from Wacké ; while it connects it with Basalt. It has often sufficient tenacity not to be scratched by copper, which leaves its mark upon it, even iron will not always scratch it.

Hornblende rock melts easily into a black and shining enamel ; this character distinguishes it from Clay-slate when it has the texture of this latter, and from Schistose Jasper when its hardness might otherwise induce us to confound it with this stone ? it generally acts on the magnetic needle ; it is divisable into two principal species.

1. *Compact Hornblende*, solid compact, difficult to break, its fracture is rugged, passing into conchoidal ; it forms the mass of the Amygdaloids of Drac, and the Derbyshire Toadstone.

2. *Hornstone Trapp.*—This must not be confounded with the Siliceous Hornstone. This variety is hard, wears down iron, but gives no sparks when struck with it ; it is compact, its grain is consequently fine and absolutely dull ; this distinguishes this stone from Basalt, whose fracture always exhibits a somewhat crystalline grain ; it breaks into parallelopipedal fragments ; its fracture is sometimes conchoidal ; its ordinary colour is black, but it is sometimes bluish, greenish, or reddish.

The trapp here mentioned is evidently a homogeneous stone, and easily distinguished by its characters from the trapp rocks. This stone is very common in different parts of Sweden. *Lydian* or touchstone so known by the use to which it is applied, might, at first sight, be confounded with Clay-slate : it is classed by Brogniart with Hornblende rock under the name of *Lydian Hornstone*, and is thus described. It is black, dull, compact ; it is softer than hornstone trapp, and has not the parallelopipedal fracture ; it is perfectly compact and sometimes a little schistose ; it may be scratched not only by iron, but even by copper, when a point or angle of the metal be used ; but when the stone is rubbed with a flat or rounded piece of copper, it receives the trace of the metal. By this character it is easily distinguishable from the blackest and most compact clay slates, which are always scratched by copper and never receive the trace of the metal in whatever way it be tried : besides, the slates do not melt before the blowpipe like this hornstone. The hornstones are sometimes found in thick strata and sometimes in masses in which no stratification can be observed.

Clay-slate is a very distinctly stratified rock. Chlorite and Hornstone are found in it. Clay-slate generally reposes upon Mica-slate, into which it often passes by insensible gradations : it is an important rock ; first, by reason of the various purposes to which its varieties are applied ; secondly as containing different metals, such as gold in the southern parts of the United States ; mercury, in Idria, &c., and, thirdly, as being regarded by some as the laboratory in which those chemical combinations or decompositions take place, the heat from which is supposed by some to be one of the causes of thermal springs. The mountains of

this rock generally present a peaked or serrated appearance.

The component parts of Clay-slate are various, and according as some of these predominate, the slate receives a particular name, and is applied to particular purposes. When a large quantity of quartz, in an impalpable powder, is mechanically mixed in the composition, it forms *Whet-slate* generally of a greenish-white colour; when magnesia is abundant, the slate becomes a *Talc* or *Chlorite-slate*, it is distinguished by its green colour and unctuous feel: with a great deal of carbon, Clay-slate becomes *drawing-slate* or *black chalk*.

The most important variety is, however, the *roofing-slate*, which, as it may be split into slabs of any thickness, and obtained of almost any size, is used for roofing, for paving, for grave-stones, for fences, for writing-slabs, &c. The best kind of roofing-slate seldom forms entire mountains, but is generally imbedded in slate rocks of a coarser kind. Good roofing-slate must split into thin plates, be light, yet compact. The loose-textured porous slates are bad, for, absorbing water, they split when seized by the frost; besides, the dust collects in the pores, and a vegetation of moss soon covers them over. Slates should be proved by immersion for a time in water, and weighing, to see how much of the liquid they absorb: the best kinds are those which absorb the least. Slates for writing on should be even and fine-grained, of a violet tinge, and somewhat soft.

Generally speaking, clay-slate presents a great variety of colour, being whitish, greenish, bluish, black, and violet-coloured.

The slate used for slate-pencils must be of a softer kind than the slates themselves on which they are to be employed; if hard or gritty, they scratch the slates, which would soon render re-polishing necessary. Slates are polished with pumice-stone.

From what has been said, the traveller will be sufficiently aware of the importance of this rock, not to neglect observing it as it deserves, whenever he may meet with it.

It may be remarked that there are slates of various formations. The primitive are distinguished by their geological associations, and by the absence of all organic remains. The slates of other formations, on the contrary, are frequently found with impressions of plants and fishes.

Mica-slate passes immediately into gneiss, over which it

generally lies, and the one rock may be frequently taken for the other in hand or cabinet specimens. It is, however, distinguished from Gneiss by the total absence of felspar, and by the great quantity, and frequently large size, of the plates of mica; so that mica-slate is essentially composed of quartz and mica. The strata of this rock are sometimes straight, and sometimes contorted in all kinds of ways. The summits of mountains of this rock are still more rounded than those of Gneiss. Mica-slate is rich in metals, which are dispersed in it both in beds and veins; it is also a repository of Emeralds.

Gneiss is composed of the same ingredients as Granite, viz., Felspar, Quartz, and Mica; indeed, Gneiss and Granite frequently pass so insensibly into each other, and into Mica-slate, that all three may be regarded as different modifications of the same rock. In Gneiss the materials, instead of being equally disseminated throughout the mass, are disposed in layers and veins, which give it the appearance of a slaty or schistose granite. It abounds in Mica, which probably gives it the slaty structure. In true Gneiss, there is less felspar than in Granite, the grains are small, and the mica abundant and arranged in layers. When Hornblende takes the place of Mica, as is sometimes the case, the rock is called *hornblende gneiss.*

Gneiss forms extensive mountains, and sometimes contains immense beds of crystalline Limestone and Serpentine. Its easy decomposition causes the summits of mountains of this rock to be frequently rounded, and the acclivities gently sloping. The same cause renders some species of Gneiss a very bad building stone; but there is a kind in the United States, which is very much used. This rock contains but few disseminated minerals, unless it be Garnets; but it is very rich in metallic veins, and the traveller may seek in it for gold, silver, cobalt, antimony, lead, copper, and iron.

The passage of Gneiss with Granite on the one hand, or Mica-slate on the other, must be particularly attended to.

Granite.—To the generality of people, all stones composed of different materials in grains are granite; and much uncertainty has sometimes arisen from ignorant travellers describing as granite, rocks which were of a nature quite different. True granite is essentially composed of Felspar, Quartz, and Mica, more or less perfectly crystallized. These component parts differ in size, colour, and relative proportion.

When large crystals of felspar are disseminated in common granite, the rock is called *Porphyritic-granite.* When large laminæ of felspar are intersected by imperfect crystals of quartz, the transverse angular sections of the latter bear some resemblance to the characters of oriental writing, and this is called *Graphic-granite;* it seldom exists in large quantity. *Syenite,* or *Syenitic-granite,* is that in which hornblende, either wholly or in part, supplies the place of mica. *Felspathic-granite,* the Whitestone of Werner, and the Eurite of the French, is that in which felspar is the principal ingredient.

Whatever be the nature of the granite, it must be distinctly specified, and the traveller will take care to observe whether it be massive, or if it have any tendency to stratification; he will notice if it rest upon any other rock, and what, as also the rock or rocks which may repose upon it. He will also remark whether the granite sends out layers or veins between other rocks, or into their mass, and whether such rocks seem to have undergone anything like change of texture or appearance in the parts contiguous to the granite. He will also observe whether the granite be sound and firm, or whether it exhibit marks of disintegration or decomposition, from atmospheric or other causes.

Granite is a rock of considerable value. As a building stone, for great works, it is unequalled by any other; its colour should be agreeable, the various ingredients distinct, and the mass solid and compact. It may be well to observe, in this place, that, for objects of a certain size, as obelisks, columns, &c., the large-grained granite is the most beautiful; whereas for vases, chimney-pieces, slabs, &c., a finer grain is preferred. The greater the quantity of mica contained in granite, the less brilliant is the polish it will take, the mica also exfoliating when exposed to the air; its great abundance must be avoided as much as possible in the choice of granite for objects to be exposed to the atmosphere. But in order that granite, or any other rock, even of the finest quality, can be quarried with advantage, it must not be too far from the spot where it is to be employed, or from easy water-carriage, otherwise it will not bear the expense of transport. It is customary to round columns and to square blocks at the quarry, in order to avoid all superfluous weight and volume.

SIMPLE MINERALS.—As many of the simple minerals are employed in the arts, and some of them are of

great value, we shall here enumerate a few of the more important.

The following are found in primitive formations, so that the traveller knowing the rocks he meets with to be of that class, may expect to find some, if not many of them.

Argil.—Kaolin and Lithomarge, see the article *Clay.*

Asbestus.—Amianthus is even now employed in the arts; it may be sought for in serpentine rocks.

Beryl.—The Aquamarine, both blue and yellow, and the Emerald.

Chlorite.—Green earth of Verona, in amygdaloid rock; it is used in oil painting.

Corundum.—Saphire-colourless, red, yellow, blue, violet, &c. Girasol or Cat's-eye, and Asteria. The transparent Corundums are the precious stones, *par excellence*, and when red, yellow, violet, &c., are called oriental ruby, topaz, amethyst, &c., to distinguish them from the common ruby, topaz, amethyst, &c., which are very different stones. These gems are generally found in the rivulets of primitive countries; nevertheless, Werner was of opinion that they belonged to the formation of the secondary trapp rocks: they have, however, been met with in the fissures of primitive rocks, and may therefore be placed in the present list.

Corundum Common, or adamantine spar. It is used for polishing hard stones.

Diallage, Green and Metalloide, or Schiller spar.—Ornamental.

Emery.—Its use for polishing metals and stones is well known; but although it belongs to the primitive rocks, it is most frequently found in deluvial deposits.

Euclase.—This stone is very beautiful, but can hardly be employed in jewellery, on account of its being so fragile.

Felspar.—Adularia, opaline, or Labrador spar, green, blue, avanturine, white, Petunze, and Kaolin. The two last are important for the fabrication of porcelain, the others as ornamental stones, and used in jewellery.

Garnet.—Both the precious and common.

Hyperstene.—Sometimes used in jewellery.

Idocrase.

Jade.—Nephritic and Saussurite.—The precise geognostic situation of the former is unknown.

Jasper.—Common, ribbon, &c.—All the jaspers are beautiful stones, and are employed for vases, snuff-boxes, &c.

Lazulite.—Beautiful as an ornamental stone, for interior architectural decoration; the finer kind is employed in jewellery. From this stone is obtained the beautiful pigment known by the name of *ultramarine.*

Mica, foliated and scaly.—The former kind, in large plates, is used as window-glass, and in some cases preferably; the latter kind is used for drying writing, and for ornamenting stucco-work, and paper-hangings, &c.

Quartz, colourless or rock crystal,—valuable in the arts. Iris, Avanturine, yellow or Scotch topaz, greenish, rose, violet, or Amethyst, blue or water sapphire, resplendent or Cat's-eye, smoky, &c. All used in jewellery.

Serpentine.—Noble. Used for snuff-boxes, &c.

Silex. Cornelian, Sardonyx, Heliotrope or Blood-stone, Chrysoprase, Calcedony, Hydrophane, Opal, Girasol, &c. All used in jewellery.

Spinelle.—The Spinelle is generally found in streams, along with the Corundums, Balass-ruby, Carbuncle, &c.

Steatite, or Soap-stone, is cut into grotesque ornaments by the Chinese. The Arabians use it as soap in their baths; it is affirmed that certain savage tribes eat a kind of Steatite.

Talc, is used in the composition of pastels for drawing, in rouge, for the ladies, &c.; French-chalk is a variety of talc.

Topaz, Colourless, yellow, rose-red, blue, &c. All used in jewellery.

Tourmaline, Crystallized; colourless, yellow, green, blue, red, black, &c.—The Tourmaline has been much employed for the polarization of light, but is now superseded.

Zircon, Jargon and Hyacinth.—Used in jewellery.

The following are found in the transition, secondary, and tertiary formations:—

Chlorite, Garnets, Jasper, Macle, Quartz, Rotten-stone, Serpentine, Silex, Talc, and Tripoli. This list is very limited, and a great part of the minerals contained in it are found also in the primitive rocks.

METALS.—The precious and useful metals are of such importance, that the traveller should never neglect to seek for indications of them as far as his time and means will permit.

It can hardly be doubted that the traveller often passes by rich metallic veins without perceiving them, either from inadvertency or from ignorance of the appearances indicative of their existence. It were therefore very desirable that

we should give detailed instructions on this subject; but unfortunately the limits of our work force us to be brief. This, however, is of the less consequence, as the methods we have already described for seeking for coal are equally applicable in the search for metals. There is, nevertheless, this difference between the two, that coal is immediately known when seen, and is usually found accompanied by rocks of a particular series; whereas the ores differ greatly in their appearance, and are found in very different kinds of rocks.

Brongniart says that the metals contained in the bowels of the earth are with certainty indicated, only by their cropping out at the surface; but he adds, that this positive evidence is often wanting, and that we may therefore have recourse to other indications, without however placing great reliance upon them.

It is of course necessary to be able to recognise the ores themselves; but if the traveller should not have this kind of knowledge, we must refer him to works on mineralogy, and to the examination of cabinets; as it is impossible for us, in a work like the present, to give the character of the several appearances of the ores. Supposing, therefore, the traveller acquainted with these, we shall merely remark that when they are not themselves discovered, the indications of their existence are,—the rolled stones found in the beds of torrents; veins in the rocks which contain stones coloured by metallic oxides; and, more particularly, the nature of the rocks themselves, as known to be generally metalliferous.

Although metals are found in a much greater variety of formations than coal, still it by no means follows that they exist in all kinds of rocks indifferently. They are much more common in mountains of moderate elevation, and in the transition rocks (as may have been gleaned from the geognostic details we have already given), than in high primitive mountains and in alluvial plains. Thus they may be sought with greater hope of success in Gneiss, Mica-slate, &c., than in Granite, compact Limestone, Bituminous slate, Chalk, &c. We speak generally, for certain metals, as Platina, Gold and Tin are found almost exclusively in primitive rocks or in alluvial formations. We have also seen rich veins of Lead, sometimes argentiferous, in rocks or compact Limestone, and if the Sulphate of Barytes and Fluor Spar are pretty certain indications of metal, they also exist in abundance in limestone formations.

The following Negative and Positive indications of the existence of metallic deposits, is from Dr. Ure :—

Negative Indications are derived from that peculiar geological constitution, which, from experience or general principles, excludes certain metallic matters; for example, Granite, and in general all primitive formations, forbid the hope of finding within them combustible fossils (pit-coal), unless it be beds of Anthracite; there also it would be vain to seek for Sal-gem. It is very seldom that granite rocks include silver, or limestones ores of tin. Volcanic territories never afford any metallic ores worth the working: nor do extensive veins usually run into secondary and alluvial formations. The richer ores of iron do not occur in secondary strata; and the ores of this metal peculiar to these localities, do not exist among primary rocks.

Positive Indications are some of them proximate and others remote. The proximate are an efflorescence, so to speak, of the subjacent metallic masses; magnetic attraction, for iron ores; bituminous stone, or inflammable gas, for pit-coal; the frequent occurrence or fragments of particular ores, &c. The remote indications consist in the geological epochs, and nature of the rocks. From the examples previously adduced, marks of this kind acquire new importance when, in a district susceptible of including deposits of workable ores, the *gangues* or vein-stones are met with, which usually accompany any particular metal. The general aspect of mountains whose flanks present gentle and continuous slopes, the frequency of sterile veins, the presence of metalliferous sands, the neighbourhood of some known locality of an ore, for instance, that of iron-stone, in reference to coal; lastly, the existence of salt-springs and mineral waters, may furnish some indications; but when ferruginous or cupreous waters issue from sands or clays, such characters merit in general little attention, because the waters may flow from a great distance. No greater importance can be attached to metalliferous sands and saline-springs. In several places it is observed that a certain ore of red oxide of iron occurs above the most abundant deposits of the ores of lead and silver; whence it has been named by the Germans, the *iron-hat*. This, however, is no certain indication.—*Dr. Ure's Dictionary.*

In order still further to assist the inquiring traveller, we subjoin the following additional extract from Dr. Ure's Dictionary of Arts, Manufactures, and Mines:—

Localities and Indications of the Principal Ores.—*Tin* exists principally in primitive rocks, appearing either in interlaced masses, in beds, as a constituent part of the rock itself, and more rarely in distinct veins. Tin-ore is found indeed sometimes in alluvial land, filling up low situations between lofty mountains.

Gold occurs either in beds, or in veins, frequently in primitive rocks, particularly in schists; it is not found in serpentine, but it is met with in grauwacké in Transylvania. The gold of alluvial districts, called gold of washings, or transport, occurs as well as alluvial tin, among the débris of the more ancient rocks.

Silver is found, particularly in veins and beds, in primitive and transition formations; though some veins of this metal occur in secondary strata. The rocks richest in it are, gneiss, mica-slate, clay-slate, grauwacké, and old alpine limestone. Localities of Silver ore itself are not numerous, at least in Europe, among secondary formations; but it occurs in combination with the ores of copper or of lead.

Copper exists in the three mineral epochs; 1, in primitive rocks, principally in the state of pyritous copper; 2, in beds, in masses, or in veins, among secondary rocks, associated now and then with ochreous iron-oxide and calamine (carbonate of Zinc); and 3, it is sometimes disseminated in grains through more recent strata.

Iron is met with in four different mineral eras, but in different ores. Among primitive rocks, magnetic iron-ore and specular iron-ore occur chiefly in beds, sometimes of enormous size; the ores of red or brown oxide of iron (hæmatite), are found generally in veins, or occasionally in masses, with sparry iron, both in primitive and transition rocks; as also sometimes in secondary strata; but more frequently in the coal-measure strata, as beds of clay-ironstone, of globular iron-oxide and carbonate of iron. In alluvial districts we find ores of clay-ironstone, granular iron-ore, bog-ore, swamp-ore, and meadow-ore. The iron-ores which belong to the primitive period have almost always the metallic aspect, with a richness amounting even to 80 per cent. of iron, while the ores in the posterior formations become in general more and more earthy, down to those in alluvial soils, some of which present the appearance of a common stone, and afford not more than 20 per cent. of metal, though its quality is often excellent.

Mercury occurs principally among primitive strata, in

disseminated masses, along with combustible substances; though the metal is met with occasionally in primitive countries.

"*Cobalt* belongs to the three mineral epochs, its most abundant deposits are veins in primitive rocks; small veins containing this metal are found, however, in secondary strata.

"*Antimony* occurs in veins or beds, among primitive and transition rocks.

"*Bismuth and Nickel* do not appear to constitute the predominating substances of any mineral deposits; but they often accompany cobalt.

"*Zinc* occurs in the three several formations, namely, as sulphuret or blende, particularly in primitive and transition rocks; as calamine, in secondary strata, usually along with oxide of iron, and sometimes with sulphurate of lead.

"An acquaintance with the general results collected and classified by geology, must be our first guide in the investigation of mines. This enables the observer to judge whether any particular district should, from the nature and arrangement of its rocks, be susceptible of including within its bosom beds of workable ores; it indicates also, to a certain degree, what substances may probably be met with in a given series of rocks, and what locality these substances will preferably affect."

When indications of ore are found, the methods of seeking for the veins are the same as those pointed out for coal. It is hardly necessary to add that, whenever a traveller discovers ore, he must accompany his notice on the subject, by every possible detail regarding the presumed direction and inclination of the vein, its thickness, the quality and apparent abundance of the ore, the facilities for working and transporting, &c., with an approximate statement of the cost of the first works. He must also take specimens; in short, he will do what he can to engage capitalists to work the newly discovered mine, if it should appear likely to prove a successful enterprise; taking great care, however, not hastily to raise hopes which may never be realized.

If the traveller be not acquainted with the ores, he should, nevertheless, take specimens of all stones which are unusually heavy, and which appear different from the generality of the stones he meets with, particularly if he find a band or slip of such in other rocks; and he must carefully note the situation where he found such stones, and their apparent abundance.

In travelling among savage tribes, the observant traveller will not fail to notice whether the natives use metal for arms, implements, or ornaments, and whether, from their uncouth workmanship, they may not be the product of their own industry; in which case, he will make cautious inquiries (so as not to excite suspicion), regarding the places where the ores exist.

MINES, MINING METALLURGY, AND MINERS. —In the vulgar and general acceptation of the word, a *Mine* means any spot where there exists an accumulation of mineral treasure, whether worked or not; thus a person is said to discover a mine, when he discovers a vein of ore, or a mass of some useful mineral; properly speaking, however, the term *Mine* should be applied only to an actual exploitation of ore, whether by open excavations or subterranean workings. The term *Quarry* is, or should be restricted, to the extraction of stone, marble, slate, &c., whether by open or subterranean workings.

The places whence valuable clays, sands, gravels, &c., are extracted are usually termed *Pits.*

The metals, whether native or mineralized and in the state of ore, are variously disposed in the bowels of the earth, as in veins or lodes, in beds, in masses, or disseminated.

Veins are of different kinds; as 1st. fissuriferous, or in form of a fissure more or less extensive, which traverses the strata of rocks in different directions, and whose planes make different angles with the horizon, these are called *rake-veins.* 2. Common *pipe* or *tubular veins*, sufficiently indicated by their name. 3. *Radiated pipe veins;* and 4, the lateral imbedded or *flat-vein.* Small veins are called *strings*, or *threads.* Veins or spaces, similar to those containing ores, are frequently found without ore, and hence veins are said to be metalliferous or quick, and non-metalliferous or dead; and the quick are said to be rich or poor, according to the abundance or scarcity of ore.

Beds are flattish deposits of ore, lying in or between the strata of rock.

Masses, as the name implies, are particular accumulations which are either found isolated, or at the point of intersection of fissuriferous veins, or at the centre of the radiated pipe-veins. Pipe-veins themselves sometimes swell out in particular places, so as to form masses. The German miners give the name of *Stockewerke* to interlaced masses, and *Butzenwerke* to isolated masses.

Metals and ores are said to be *disseminated* when they are irregularly disposed in specks, patches, nodules, or nests, throughout the mass of the rock.

The principal parts of a vein are the *roof*, or overhanging side; the *floor*, or underlying side; the *head* of the vein, or that part nearest the surface; the *lining*, which is generally thin layers of an earthy or argillaceous nature, lying between the metallic vein and the bare rock. Nests, or *Cavities*, generally lined with crystals.

Besides the ore, properly so called, veins contain stones more or less penetrated with, and altered by the existing metals; and almost all veins are occupied by certain earthy salts and other stones, as fluate of lime, sulphate of barytes, quartz, &c., called veinstones, the presence of which is frequently an indication of the existence of ore.

Direction, Inclination, and Thickness of a Vein.—A vein, disregarding its thickness, may be considered as a plane variously directed and inclined. A horizontal line drawn in the plane of the vein is called the line of direction or bearing, and the bearing of the vein is the points of the compass to which the extremities of this line point. Another line, drawn also in the plane of the vein, but perpendicular to the former, is called the line of dip or inclination, (by miners the *hade* or *hading*), and the angle this forms with the horizon is the dip, or inclination, or hade of the vein. In regular pipe-veins the hade and bearing are one and the same, being a line drawn in the axis of the vein. The thickness of a vein is called its power.

Irregularity of Veins.—Veins are seldom or never perfectly regular. Thus their bearing deviates in detail from the general bearing taken throughout a great length; the dip is less liable to change, still it is not always uniform. The thickness of the vein also varies very considerably, being in some places of great power, and in others so thin as to be almost lost. The veins are also liable to be *heaved* or *started* by derangements called *shifts* or *faults*. The richness of the veins also varies in different parts, and the veinstones also change.

The way in which ores are deposited differs not only in different countries, but often in contiguous provinces of the same country, and in different mines in the same province.

It is observed that both the thickness and hade of a vein differ according as the vein passes through a hard or a soft stratum. In secondary strata the veins are generally poorer

as they descend. The walls or cheeks of veins are generally observed to have their mode of aggregation and general appearance different from that of the same strata further back. The strata are also tilted up or bent down in the immediate neighbourhood of the vein.

It is said that N. and S. veins are generally not so rich as E. and W. veins; their mechanical and chemical contents are more of an earthy and alkaline nature, and they have their walls in a more decomposed and disintegrated state. The longitudinal course of N. and S. running veins are in general more straight, of greater length, have fewer strings or small veins branching from them, and, in general, have greater and more uniform inclination than those having an E. and W. direction. N. and S. veins are usually richest at their intersection with E. and W. veins.

Single veins, or such as are at a great distance from other veins on either side, and have no strings or feeders falling into them, are generally unproductive. When such veins are proximate and parallel, one or more will generally be productive. There is generally ore at the junction of two veins. It is also observed that veins are most productive at or near the junction of dissimilar rocks.*

From what has been said of veins, it is presumed the intelligent traveller will be able to glean the nature of the observations he should make on them, whether he has to examine such as are known and worked, or whether he would seek for and describe such as were before undiscovered. We now proceed to say a few words on mining operations.

EXPLOITATION OR WORKING.—It may not be useless to insert in this place a few words on the exploitation or working of mines, the mechanical preparation of the ore, and on metallurgy properly so called; the more particularly as in all statistical accounts, mines, from their importance, deserve to be separately considered; and although this subject might be treated of under the head of *Industry*, we have thought well to keep together, as much as possible, those things which, to be well understood, should be observed together. Thus, having spoken of the different ways in which the ores are found in the earth, we proceed to give some information on the methods of obtaining them. Whenever there are no underground works, the mineral is said to be quarried or extracted by *open workings*, and the spot where

* LEITHART, "on Mineral Veins."

such workings are carried on is called a quarry or pit, unless the mineral be an ore, when the place is still called a mine. Underground workings are, however, much the most frequent in the case of metallic ores, coal, and salt. These subterranean excavations have different names, according to their nature and intention.

Shafts and Galleries.—The shaft is a perpendicular or highly-inclined pit or well. It may be either cylindrical or prismatic, large or small, deep or short. The use of the shaft is either for the descent and ascent of the miners, or for the extraction of the ore, or for the ventilation of the mines. Sometimes the same shaft is used for all these purposes. The pumps, by which the mine is freed of water, are also placed in the shafts. Galleries are horizontal or very slightly inclined passages, which, when they run in the direction of the bed or vein, are called *longitudinal*, or galleries of prolongation, and when in a direction perpendicular to this, are called *transverse* galleries. They also receive other names; as principal galleries, lateral galleries, cross galleries, drain galleries, &c. Along the galleries the ore is transported, and they, together with the internal shafts, are the means of communication throughout the mines. The kind, the number, the direction, and the dimensions of the shafts and galleries of mines, depend entirely on the situation, nature, and direction of the vein or veins to be worked, and the rocks to be traversed; the principal conditions being to unite economy with security against the encroachments of water, the falling in of the rock, bad air, and other accidents which may endanger the safety of the miners and the success of their labours.

Excavation of the Rock.—The mode of excavating depends chiefly on the nature of the rock: if it be soft and crumbling, the pick and shovel are sufficient; if it be solid and compact, blasting with powder, or disaggregating by means of fire, are the methods employed.

Timbering and Walling.—These operations are necessary for sustaining the roof and sides of the shafts and galleries, and prevent their falling in. The timbering is effected by means of complete frames, or simple stancheons and planks called *facing boards*. The resinous woods are observed not to last so long for this purpose as oak, beech, &c. Walling is of course stronger and more durable than timbering, and is both more solid and more economical when the bricks or stones are united by a cement.

Drainage.—The water, which is one of the chief obstacles to mining operations, is drawn out from the mine by means of pumps worked by steam, by water or wind, or by animal labour. In some cases drain-galleries are alone sufficient to carry off the waters of the mine, and these are sometimes of very great length. The water is sometimes prevented from coming into the mine at all, by means of proper walling or timbering (termed by the French *cuvelage*).

Ventilation.—The fourth grand object in mining is the complete ventilation of the mine, which is effected in various ways; as by a judicious system and play of doors in the galleries, by fires at the bottom of the shafts, by exhausting pumps, &c. This is of the utmost importance, as the air of mines is often foul by reason of the gases liberated by spontaneous decompositions, by the breathing of the workmen, the combustion of the lamps or candles, &c.

Lighting.—Mines are lighted by means of oil-lamps or candles, &c. Occasionally a steel cylinder has been made to revolve with rapidity against a silex, which produces a brilliant stream of scintillations, sufficient to light the work without risk of exploding the inflammable gases. The invention of Davy's Safety Lamp is now very general in mines, subject to fire-damp.

Attack of the deposit of Ore.—The way of working is different according to circumstances; when the ore is *in veins*, it is attacked in two ways, the one called by *ascending*, and the other by *descending steps*, each having its peculiar advantages. A third mode is sometimes practised, called *stripping the vein.* When the ore is *in mass*, a mode of attack is employed called *cross-working*, in which, in lieu of proceeding by steps, the advance is made by galleries through the whole thickness of the mass: these galleries, being afterwards filled up, serve as floors for the superior galleries, and so on.

Very thin beds are worked in a way peculiarly fatiguing to the miners. As it is important to excavate as little of the bare rock as possible, in order to avoid expense, the miner, almost naked, works lying on his back beneath the layer of ore, the detached pieces of which he places in a kind of shallow trough fastened to his feet, and which he drags out by crawling along his confined passage.

Extraction of the Ore from the Mine.—This operation is differently performed in different mines; sometimes the miners use barrows or boxes, which they push along the

galleries to the foot of the shaft: sometimes the same machinery which serves to draw the *corves* up the shaft also drags them along the galleries; sometimes wooden or iron rails are laid down in the galleries, by which the labour is greatly diminished. The corves are made to ascend the shaft by means of a rope or chain, which passes over the drum of a *gig* or *whim*, worked by any sufficient or convenient power. The miners sometimes ascend and descend with the corves, and sometimes by ladders placed in the shaft.

Mechanical preparation of the Ore.—Previous to submitting the impure ores to those metallurgical operations by which the pure metal is to be obtained, they must be submitted to certain processes, whose object is to free them, as much as possible, from the stony substances with which they are mixed: these operations are *Picking*, *Breaking*, *Sorting*, *Sifting*, *Stamping*, *Crushing*, *and Washing*.

Picking is performed underground in the mine itself. It consists in the separation of those pieces of the rock containing no ore from those containing ore; the former serve for filling the old excavations in the mine. After this rough picking, the ore is taken out of the mine, when, the pieces being broken with hammers, a second *sorting* takes place; the whole being usually *sorted* into three portions: 1st. the *gangue* or rock, which is thrown away; 2nd. the ore for the *stamping* or *crushing*-mill; and, 3rd, the pure ore or richest pieces. This operation is generally performed by old men, women, and children.

Sifting is an operation by which the pieces of ore are separated into sizes, or the ore in the fine rubbish separated from the mere stones by the action of the sieve or riddle in water, the different substances arranging themselves in layers according to their specific gravity. The operation of sifting or riddling differs in different countries, and varies also with the nature of the ore.

Stamping is performed by huge pestles of wood, shod with iron, which being successively raised to a certain height by the cams of a horizontal revolving tree, fall by their own weight, and thus pulverize the ore placed beneath in a trough. The stamping is sometimes performed dry, but more generally a current of water is made to pass over the pounded ore, whose finer particles are thus carried off and deposited in proper receptacles.

Crushing, like stamping, is an operation by which the ore

is reduced to a coarse sand. It is performed by means of iron cylinders revolving in contrary directions, by means of which the pieces of ore are seized and crushed between the revolving rollers: it is much used in the copper-mines of Cornwall.

Washing.—The small rubbish from the mine, and that which results from the breakage, and the powder from the dry stamping, is a mixture of different ores and stones, which it is necessary to separate in order to get rid of the stony matter, and to be able to treat each several ore separately, and to the greatest advantage. This separation is accomplished by *washing*, an operation performed in a variety of ways, and by very different management in different places; but the object in all is the most perfect separation possible of the pure ore from its gangue, and of the different ores from each other, by means of their different specific gravities.

Metallurgy, strictly speaking, is the art of extracting metals from their ores, and bringing them to the requisite degree of purity; but the term has been extended to those chemical operations performed in the great way, by which other products of the ores are obtained besides the pure metals, as alumena, sulphur, arsenic, sulphate of iron, of copper, &c.

The operations of metallurgy are purely chemical; but as great masses of matter are to be acted upon, the metallurgist is precluded from using the various expensive reagents which the chemist employs in the laboratory for the exact analysis of ores. In the processes of metallurgy, therefore, the reagents are few and simple. Fire is the principal agent, to which may be added, 1st. in many cases, the ores themselves; 2nd. earths and stones, which, according to their nature and composition, are employed as fluxes; 3rd. coal and charcoal, which serves not merely for smelting, or for subliming or volatilizing certain substances, but which, in many cases, may be regarded as a deoxidizer; 4th. air, which is employed not only for urging the fire, but is used also as an oxidizer; 5th. mercury and water, which are the only solvents employed in operations performed in the cold way. Our confined limits will not admit of our entering into more detail on this subject, but we deem it advisable to say a few words on furnaces in general.

Furnaces.—All furnaces are composed of four principal parts, sometimes separate, and sometimes confounded together

as to their situation, though never as to their respective functions. These parts are the *hearth*, the mouth or *vent*, the *laboratory* and the *chimney*. This division applies alike to all furnaces, however complicated they may appear. The *hearth* is that part where the combustible, whatever it may be, is placed ; it is *single and lateral*, in reverberatory furnaces, in cupellation furnaces, &c. : it is *multiple and lateral*, in the cylindrical porcelain furnaces, &c. ; *central*, for those for antimony and brass ; *inferior*, or beneath, in most lime-kilns, evaporating stoves, roasting furnaces, &c. ; *superior*, or above, in furnaces for amalgamation, refining of iron, &c. ; *enveloping*, in the blacksmith's forge, in assaying furnaces, bakers' ovens, brick-baking furnaces, &c. The *Vent*, or mouth of a furnace, is that part by which it is principally supplied with air ; its direction and position may sometimes be varied without any change in the other parts, which greatly modifies the effect of the furnace. Air-pipes and bellows are its appendages. The vent is *inferior* in the greater number of the reverberatory furnaces ; *lateral*, in evaporating and distilling furnaces ; *superior*, in porcelain and all other furnaces in which the combustible burns with a reversed flame ; and *lengthened*, in blast furnaces ; the action of the vent is increased by air conduits and blowing machines.

The *Laboratory* is that part where the substance to be acted upon by the combustible is placed ; crucibles, canals, or conduits, receiving basins, chambers of sublimation, &c. are its appendages. The position of the laboratory is regulated by that of the hearth ; sometimes the two are confounded into one. The laboratory is *close* in distilling, evaporating and subliming furnaces, aud in all those where the matter subjected to the action of heat is contained in particular vessels, and receives the heat indirectly.

The *Chimney* is that passage by which the heat, together with the smoke and other volatile products of combustion, are conducted away. The chimney sometimes goes immediately from the hearth, in which case the current of heat does not traverse the laboratory ; the furnaces constructed upon this principle are those which consume the greatest quantity of combustible ; such are the ordinary distilling furnaces, and those whose hearth is *superior*, &c. The chimney is *intercepted*, when the current of heat traverses the laboratory ; *interrupted and free*, when it is formed by

the substances themselves which are in the laboratory, as in lime-kilns, smelting furnaces, &c., and in all open roasting places; *interrupted and partially free* when the current of heat, after having passed freely through the matter subjected to its action, is surrounded at its exit by a tube, as in the reverberatory and some other furnaces; *interrupted and confined* where the current of heat traverses the laboratory through a particular conduit, as in those boilers which are traversed by the chimney, &c. The chimney is *multiple* when the current of heat, and the gases which it bears along with it, escape by several openings, as in the case of porcelain furnaces. In general descriptions, the name of chimney is often confined to that part alone which is beyond the laboratory.

There are various kinds of furnaces, destined for particular purposes; and for the same purposes the furnaces are differently constructed in different countries.

Blowing machines.—These are of various constructions, and the means by which the air is forced into the furnaces may be wind, water, steam, or animal power.

Chemical preparation of the Ore.—This includes various operations and processes which we cannot here detail, we must, therefore, confine ourselves to a word on roasting.

Roasting.—The object of this process is either, 1st. to drive off the sulphur, arsenic, &c., which must be got rid of; or, 2ndly, to oxidize certain ores in order to render them attackable by acids; or, 3rdly, to render them more fragile and more easily acted upon by the air or other agents by which they are to be modified. In the case of some of the ores, one roasting is sufficient; others, again, as the ores of copper, require sometimes as many as fifteen or more roastings. There are three ways of roasting; in *open heaps*, in *walled areas*, and in *furnaces;* each of these methods has its peculiar advantages and disadvantages. The other principal Metallurgical operations, chemical and mechanical, are, *Smelting*, *Refining*, *Hammering*, *Rolling*, *Cupellation*, *Amalgamation*, *Liquation*, *Cementation*, &c.

In the foregoing notice of mining and metallurgical operations we have alluded to the general practice of those countries where science has been applied to the art; but there are many cases where savages, or even the peasantry of civilized countries, obtain many useful and valuable mineral products by means of the most simple processes

and ingenious contrivances. It is hardly necessary to add, that an intelligent traveller will not fail carefully to examine such, as they may sometimes be advantageously employed, or may furnish hints of great practical importance.

Having thus rapidly sketched the principal objects of attention regarding veins, and the extraction of ore and its treatment, it is an easy task to deduce the nature of the observations to be made on these objects. Thus, after having observed the situation and extent of the vein or veins, of the mass or bed, together with the dip, strike, &c., it will be necessary to observe (if it be worked), whether it be by open workings, or by shafts and galleries, &c., and in detail how the different operations to which we have drawn attention are performed, pointing out particularly whatever is most interesting. Having done all this, and obtained all the necessary information regarding expense, profits, &c., the whole should be compressed into a tabular form, which points out at once all the objects necessary to be noticed for each particular mine. From these partial tables a general table should be made out, accompanied by observations on the history of the several mines, the laws by which the mines generally are regulated, pointing out also to whom the several mines belong, to what conditions they are severally subject, and by whom worked. What degree of encouragement is given to mining in general, or to the searching for, or working of, certain mines in particular.

It now only remains for us to say a word on

Miners.—As for miners, their labour is always hard, generally cheerless, and often dangerous ; so much so, indeed, that it is the custom, in certain countries, to work the mines by condemned criminals ; fortunately, however, there are not criminals enough to supply the necessary number of miners, so that free men are employed, and, when there is a choice, the convicts are sent to the more dangerous mines. In all cases, good and bad men should be kept apart.

The life of the free miners is so essentially different from that of any other labourers, that they form a separate and distinct class of men, whose manners and customs are peculiar, and who, not unfrequently have a language or jargon of their own. When they are in great numbers they have particular laws and some exclusive privileges.

The fate of those men who voluntarily submit to a life of

hard labour in the bowels of the earth, enjoying but rarely the glorious light of heaven, and breathing most frequently foul air, who seldom live long, and often contract the most cruel chronical diseases, who are continually exposed to dangerous accidents, and who too often meet death in its most horrid forms, must ever be matter of deep interest to the philanthropist, and is at all times deserving the particular attention of governments. Thus any thing which can be contrived to secure them from danger and sickness, every thing which may lighten their task or relieve their sufferings, every thing which may secure a proper subsistence for the widows and children of miners, when these shall be dead, or when, from mutilations or from illness contracted in the mines, they are no longer able to work, should be done. If these things are neglected, it speaks ill for the humanity of the government, or of those who have the regulation of the matter.

Nor is it solely for the free miner that we should be interested ; the convict, notwithstanding his crimes, is deserving of our pity ; and as we must ever regret the necessity for punishments at all, so must we particularly deprecate all such as are not inflicted with a view to amend and reclaim the guilty. Penal labour in the mines should therefore be attentively examined into, as to its nature, object, and result, and every information possible gleaned as to the convicts themselves. In conclusion, then, there can hardly be a more interesting object of investigation for the traveller than the statistics and moral habits of a mining population: thus, he should note the numbers and ages of both sexes employed in or about the mines, the kind of labour allotted to each sex, the time passed under ground, the peculiar dangers or difficulties of the several operations, the general state of health, the particular diseases, the frequency and kind of accidents, the mean length of life, the remuneration for labour, and manner in which it is determined and paid, and the degree of skill exhibited in the several operations; the state of morals and instruction, the prejudices and superstitions, &c., of the miners; the benevolent establishments instituted for their benefit, how and by whom supported ; the particular laws to which the miners are subject, their privileges, remarkable usages and customs, and particular language or jargon. In a word, every thing of this kind is exceedingly interesting, and should be minutely

examined into by the traveller whenever he may have a favourable opportunity for so doing.

VOLCANIC SOILS AND PRODUCTIONS.—When the celebrated Dolomieu says that "Volcanoes have performed an important part in the ancient history of our globe, that they have contributed to the formation of our continents and mountains," we perfectly agree with him, as will probably every one else ; but when he adds, that "it is important for us to know, when, how, and under what circumstances these volcanoes have acted," we are no longer of his opinion, and that for several reasons ; 1st. An object which it is impossible ever to attain, appears to us to be without importance, and it is more than probable that we shall never know the history of ancient volcanoes, and of those successive convulsions of which the surface of the earth bears such evident marks ; and even should we know at what precise epoch, how, and under what circumstances volcanoes have acted, this knowledge can serve no other purpose than to satisfy a vain curiosity ; for, with all our knowledge, we should no more be able to secure ourselves from the effects of their dreadful irruptions, than we now can with our ignorance of the laws to which they are subject.

We therefore place this kind of knowledge to which Dolomieu attaches so much importance, in the class of speculations more curious than useful. But what we regard as of practical utility would be the possibility of predicting irruptions, so as to be able at least to save our lives and a part of our property. It is also useful to know the uses to which the various volcanic productions are or may be applied, as well as the means of distinguishing them.

What is quite legitimate and very interesting for those who have a taste for Lithology is, to examine the various volcanic formations, to specify the substances which compose them, and to describe what may have been seen or discovered in order to add new facts to Geognosy.

Solid lavas and basalts, we are informed by Mr. Raspe, are employed in Hessia, 1st. for paving the streets and roads ; 2. as a building stone ; 3. when naturally prismatic they are set up as posts in the corners of the streets ; 4. as palisades and enclosures for fields and gardens ; 5. for rural decorations ; 6. when cut and polished, (which is very expensive an account of their hardness,) they may be employed in sculpture and architecture. Schistose lava may be employed as slabs.

Every one has heard of the use of puzzolana; this substance is heavier than scoria, less swollen and blistered, and more argillaceous. These characters may serve to distinguish them. One sometimes finds below lava currents, baked clays which may serve as puzzolanas. Scorified lavas, though very light, are yet sufficiently strong to be used in building, and are very good for road making. Dolomieu says there are some that are flat and which serve for roofing. Volcanic ashes are very fertile, and they are sufficiently ductile to be used in pottery; in this respect they differ essentially from volcanic sands, with which they are often confounded; moreover they differ by their grain, their weight, their colour, &c. Some lavas contain vitrified stones, whose colour and hardness are no way inferior to the colour and hardness of precious stones, and which may be advantageously employed in jewellery. In Iceland are found calcedonies of great beauty, and in larger pieces than those which come from the East Indies; every one is acquainted with those singular productions the *Achates enhydros.*

The extension, perhaps already too considerable, which we have given to mineralogy, forces us to be brief in this article on volcanic soils. There is, however, an observation which it is essential to make,—it is this; that although volcanoes have certainly greatly contributed to the formation of the crust of our globe, it by no means follows that all mountains which present us with volcanic productions are extinct volcanoes. Ancient volcanoes, as Dolomieu very justly remarks, have sometimes covered with their productions an extent of country extending to a distance of sixty leagues in all directions from the centre of their action. An attentive observer, will not only be able to distinguish an extinct volcano from what is only a superficial covering of volcanic productions, but in many cases he will be able to trace out and discover the principal focus whence the several currents of lava have been ejected.

When the traveller finds himself in a volcanic region, his attention should be directed to two principal objects; 1st. the modifications of the surface occasioned by volcanic action; and 2dly. the nature of the volcanic rocks, their form, and distribution.

The effect of volcanic action is to dislocate the rocks forming the superficial crust of the earth; these are either raised in some places, and depressed in others, by very slow degrees and without apparent commotion, or are suddenly

rent and tilted up in various ways, sometimes by a mere gaseous explosion, which rends the rocks and disperses their minor fragments to a greater or less distance, and sometimes by the boiling up of melted matter of various kinds, and in different states of fluidity, which, after forming one or more passages for itself, collects and cools into lumpy forms immediately above the vent, or spreads like a mantle over the upheaved rocks, or flows in streams to greater or less distances from the place of emission. Sometimes the bursting of the earth's crust is accompanied by torrents of water, or of wind, and sometimes an irruption is accompanied by several of these phenomena at the same time. The effect, then, of such commotions, the shock of which is occasionally felt at great distances, must be considerable, to modify the surface of the region where they occur. These modifications are direct or indirect. The direct consist in the formation of ridges, table-lands, isolated cones and domes, or a mixture of these; the formation of valleys by depression or by elevation, or of chasms by disruption; land-slips, fall of mountains, the filling up partially or wholly of valleys by accumulations of lava, scoriæ, tufa, &c.

The indirect modifications are occasioned by the drying up of springs and ingulfment of rivers, the bursting out of new water-courses, the damming up of rivers, and formation or emptying of lakes, &c. The subsequent action of water and atmospheric influence, superadded to the already induced mutation, extends still further the surface modification, and increases the difficulty of eliminating and describing each separate cause and effect. It is also well to observe that many of the ancient volcanic commotions seem to have been combined, or to have alternated, with cataclysmic action, which has increased the confusion; the repetition also of eruptions at greater or less intervals, and the difference in the violence and duration of these eruptions, induce still further changes.

These few words are sufficient to give the traveller an idea of what is meant by the modifications of the surface, occasioned by volcanic action. To elucidate them properly, requires a thorough knowledge of the subject; nevertheless, there are many points of absolute fact, unconnected with theory, which the intelligent observer will do well to note, such for instance as the extent, direction, nature and disposition of the volcanic rocks; their connexion with rocks not volcanic; the height and slope of Domes and Cones; the

dimension of Craters, both of eruption and of elevation; how far the dip of the strata round centres of volcanic action be *quaquaversal* or otherwise; the direction and extent of upheavements, of land-slips, of fissures, of lava-currents; basaltic, trachytic, and other masses, &c.

As for the nature of the volcanic rocks, they may be trachytic, basaltic, or lava, or modifications of these, as Perlite, Trachytic, or Basaltic-porphyry, Phonolite, Volcanic-tufas, Conglomerates, Cinders, Puzzolanas, &c. These substances are infinitely varied in their mineralogical characters, by the nature, the quantity, and the particular state of the minerals that are associated with them; they are also varied as to compactness, fracture, texture, and the forms they assume in mass, as tegular, columnar, spheroidal, &c. All these matters are worthy of the traveller's attention, and if he be not acquainted with the substances themselves, he should take specimens of such as are different, noting the position in which he finds them as regards each other, the general texture of the rock, the extent in all directions of the masses of each different kind, the direction and extent of the fissures, as regards the surfaces of the mass, &c.

Whenever lakes are formed in what appear to be old volcanic craters, the traveller should take every pains to assure himself of the fact of the hollow being in reality a crater, as the existence of lakes in such situations is positively denied by some.

Besides phonolite, which is sometimes used for roofing, and cellular lava, good for millstones, volcanic regions produce Sulphur, Pumice, Obsidian, Alum, Asphaltum, Olivines, and the precious Opal.

The gases emitted from Volcanoes and Solfataras, should be collected in well-closed bottles (*see operations*); and sublimations, efflorescences, and chrystalisations, from the surfaces and cavities of volcanic rocks, should be removed with care, and such as are deliquescent, well-secured from contact of the air.

We have already hinted at the changes induced in rocks, from the contact of the melted matter of injected dykes; the changes which such injections of lava occasion in the contiguous older lavas, trachytes, &c., must in like manner be noticed, as well as the alterations produced on the surface of the rocks, by the gases emitted.

EARTHQUAKES.—Several of the effects we have been

considering as occasioned by volcanic action, are the result of that particular modification of it known by the name of Earthquakes ; these are sometimes accompanied by eruptions, but generally they are not so. Sometimes there is merely a trembling or undulating motion of the ground in certain directions, and to certain distances ; and sometimes the effects of the pent up gases and vapour in their endeavour to escape, rend, upheave, and otherwise disturb the surface rocks. The sea, in the neighbourhood of a region subjected to an earthquake, is generally thrown into greater or less commotion, retiring at one moment from the coast, and returning with overwhelming fury the next. Some countries are but little subject to earthquakes, in other places they are frequent. Whenever the traveller has an opportunity of observing them, or their effects, he should particularly notice the direction (see OPERATIONS) in which the undulatory movement is effected, its violence, and the duration of the shock or shocks, with the interval of time between each ; the date, the hour of the day or night, the kind of weather which immediately preceded and which follows the commotion, and the details of its effects, disastrous or otherwise.

No single traveller can observe the distances to which any earthquake is felt, nor the direction elsewhere than at his own immediate station ; but he should make the most diligent enquiry to ascertain these points as far as possible.

VOLCANIC ERUPTIONS.—If the traveller should happen to witness an eruption he should not fail to observe, as far as he is able, all the phenomena by which it is accompanied, preceded and followed ; specifying the dates, hours, and minutes, at which every particular paroxysm or other circumstance commences, and its duration ; the height, colour, and appearance of the so called flame, and of the smoke ; the vertical and horizontal distance to which the several ejected substances are thrown ; the size, form, and nature of these ; the various streams of lava, the places whence they issue, the direction they take, the distance to which they extend, and the effects they produce ; such as the firing of forests, the damming up of streams, the filling of hollows, the overwhelming of habitations, &c. ; the changes effected in the crater of the volcano by the new eruption, the number, relative size, and situation, of new lateral craters or vomitaries, and the water cold or hot, or the mud vomited by the volcano (fish have been some-

times ejected with the water); the volcanic dust and the distance to which it is carried; notice being taken at the same time of the force and direction of the wind at the earth's immediate surface; the opening of new springs, or the drying up of old ones; the earthquakes and noises by which the eruption was preceded, or is accompanied; the thunder and lightning; the appearances of the atmosphere, and the meteoric phenomena, &c. &c.

Some volcanoes are almost always smoking more or less, and as such may often be approached without much danger, by using caution, the traveller will do well to examine them minutely, and to make a note of all the phenomena he may observe.

CAVERNS.—Caverns, caves, and grots are too curious in themselves and too interesting as connected with the phenomena exhibited by the earth's crust to be passed over by us in silence. Before entering, however, into an examination of the particular observations to be made on them, it may be as well to endeavour to fix a precise meaning to the different terms frequently used synonymously.

Caverns are natural hollows existing in the solid crust of the earth; they may be large or small, open at both or only at one end, horizontal or inclined, and sometimes modified by art.

A Grot is a small hollow, a kind of natural niche of little depth and height, and sometimes adorned with stalactites, festooned with creeping plants, and if near the sea, paved with pebbles and shells.

A Grotto is an artificial grot; it differs from a cave inasmuch as it is constructed for the purpose of an agreeable retreat, and is more or less fancifully adorned, whereas a cave is excavated for the purpose of secluded habitation, mortification, and penance, or for the concealment of illegal practices and of those who follow them.

Cells are small chambers artificially excavated, either for the habitations of anchorites, or as family sepulchres, &c.

The origin of caverns is doubtful, nor can any single hypothesis apply to the different circumstances under which they are found to exist; it is probable they have been formed in different ways. Generally speaking, caverns are almost exclusively found in calcareous rocks, though they are occasionally met with in others, as in sandstone and trapp rock. As the causes which formed the caverns in rocks of different kinds were probably different, so this circumstance

and the nature of the rocks themselves, occasion corresponding variations in the form, extent, and particular appearance of different caverns.

The observations to be made on these natural curiosities by the traveller, are—

The nature of the rock in which they exist.

The precise situation of the opening; its form, dimensions, and appearance.

The extent of the cavern; its dimensions, the slope of its bottom or floor, and the direction of that slope; the perpendicularity or inclination of the walls; the form of the roof.

Whether the caverns consist of one or several chambers; and if of several, whether these communicate in a continued line, straight or winding, or whether the chambers communicate with each other by anastomosing and intricate winding passages; whether the chambers are all on the same floor, as it were, or whether any are situated above one another.

Are there any stalactitic or stalagmitic formations in the cavern generally or in particular parts of it? if so, note the nature, extent, and appearance of these formations.

Is there any mud, sand, or rolled stones in the cavern of the same nature as the rock itself, or differing from it.

Are there any bones in the cavern? these are often not to be discovered but by digging in the mud or clay which forms the soil of the cavern. When bones are thus discovered, the best specimens of the different kinds should be selected, and their positive and relative proportions determined as nearly as possible.

Is the cavern open at both ends?

Is there any evidence of erosion by water in the cavern, though there be no running water in it now, and at what height are these water marks?

Is there any running stream in the cavern? and, if so, does the stream enter at one end and go out at the other, or does the stream rise in the cavern and flow thence, or does the cavern, on the contrary, receive and swallow up, as it were, the stream; or, as is sometimes though rarely the case, is there found in the cavern a running stream that does not come to the surface any where near the cavern? Are there any water marks indicating that the water has been higher than it now is?

When a stream flows right through the cavern is there

any sensible difference in the quantity of water which enters and that which flows out? Can the stream be traced throughout its whole course or not? What time does a floating body, thrown in at the place where the stream enters the cavern, take to arrive at the outlet?

Are there any cataracts or waterfalls in the cavern: if so, what is the height, dimension, and nature of the fall?

If the depth of the cavern through which a stream flows be very trifling, and the sky may be seen right through it, the cavern becomes a kind of natural bridge or tunnel.

Are there any stagnant waters in the cavern, as pools or lakes? Such are sometimes of considerable extent; what are the dimensions and depth of these?

Have the waters of the cavern any particular quality, and what?

Is there any constant or only occasional drippings of water from the roof of the cavern, or oozing of water down and through the sides of the cavern: is this abundant or sparing?

What is the temperature of the air and of the water of the cavern compared with the external air?

Is the air of the cavern pure, or does it contain any deleterious gases, and what? A lighted candle placed on the floor of the cavern will, by its being extinguished, indicate the existence of carbonic acid gas, which otherwise might be unnoticed.

Do any animals inhabit the cavern, as wild beasts, bats, owls, serpents, &c.? Do any vegetables grow in the cavern, particularly in parts excluded from the light, and if so, is any thing remarkable observed in their colour, &c., as compared with the same plants growing in the light?

Are there any indications of art having been employed to extend or render the cavern commodious as a dwelling?

Is there any sculpture or painting on the walls of the cavern; if so, draw and describe these?

Are any objects of art found in the cavern, as broken utensils, &c., or any mark of fires having been kindled?

Is there any remarkable echo in the cavern, or any phenomenon particularly deserving of notice? Such, and other observations of a similar nature, should be made by the enquiring traveller, when he meets with unknown or imperfectly described caverns. He may also endeavour to ascertain the most probable cause of the formation of the caverns, stating the circumstances on which he founds his opinion.

Calcareous Alabaster, which, being a substance found in

the caverns of limestone rocks should be mentioned here, is very worthy of notice as being highly prized for certain objects. The stalactites and stalagmites of calcareous caverns sometimes attain considerable magnitude, and in some cases, entirely fill up the cavity in which they are formed, which then becomes a mine of alabaster. Its usual colour is honey-yellow, but it is also met with of other colours, as shades of brown, red, and even blue. These colours depend upon the metallic oxide which the water meets with in its passage, and they are usually distributed in bands or zones variously contorted. In many places this beautiful substance is quarried and worked into vases, tablets and other ornamental objects. It was much prized by the ancients, and used for lachrymatory and cinerary urns. They seem to have preferred the honey-yellow uniformly tinted variety, perhaps on account of its greater rarity; but the zoned kind, known by the name of Onyx-alabaster, was, and is still, much esteemed. The traveller will not fail to notice deposits of alabaster whenever he may discover any.

GEOLOGICAL CHANGES.—The existence of every thing in nature depends on the continual energy of action and reaction; and the wisdom of the Creator is in nothing more evident than in the establishment, among the elements of the universe, of a constant tendency to an unattainable equilibrium. The motions of the air and water, and the unceasing metamorphoses of matter, are the result of this tendency to an equipoise of power, which cannot be effected throughout the several elements of the creation without the total annihilation of life and motion. It would seem as though the definite proportions of all the elements being once arranged in the Divine mind, a single one was added in excess, which destroyed the equilibrium and set the whole in action. Be this as it may, the motion still continues, and while its effect is to maintain the general existence of the whole, it creates perpetual change in all the parts. Thus the surface of the earth is continually varying in its details, but the operation being, in most cases, slow, is hardly remarked but by the attentive eye of the close observer of nature.

Of the various geological changes some are occasioned immediately by chemical, and some by mechanical, agency. These changes and their causes should be attentively examined, for they are of importance to the welfare of mankind,

and are, independently of this, highly interesting in themselves.

Among the most remarkable of these changes we may enumerate the formation and the dessication of lakes; the encroachments and recessions of the sea; the formation and disappearance of islands; the junction of islands with continents, and the insulation of peninsulas; the risings and the depressions of the land; the crumbling of mountains and the elevation of valleys; the changes in the course of rivers, and the accumulation of alluvial deposits; the formation and extension of dunes; the fall of cliffs; the formation of landslips; the opening of chasms; the formation of rocky masses by the agglomeration of detritus; the induration of clays; the cementation of tufas; the precipitation of travertins, &c. These and other objects of like kind, together with all the phenomena that accompany volcanic eruptions and earthquakes, are highly deserving the attention of the philosophic enquirer, and all such changes as may be appreciated by time and extent should be carefully investigated, in order to establish data as materials for a more perfect acquaintance with the globe we inhabit. Several detailed observations on this subject will be found dispersed in various parts of the present work, and for the rest we must rely on the sagacity of the reader.

FOSSILS.—The term Fossil was for a long time, and is still, with some authors, synonymous with *mineral;* we, however, confine it to those objects in the mineral kingdom, which presenting the figure, the impression or the structure of animals and vegetables, indicate with certainty that they owe their existence to organized beings.

Ill-informed persons very frequently confound, under the general denomination of *petrifactions*, every kind of fossil appearance. Now there are *petrifactions, incrustations, casts, and impressions. Petrifactions* may be produced by three different processes; 1st, by the *intermission* of mineral matter into the original interstices, cavities, or pores, of the organized body; 2d, by *substitution;* the mineral matter by degrees replacing the organized substance, as the latter disappears; or, 3d, by the *impregnation* and *consolidation* of the organized substance, itself chemically changed.

The mineral substances of which petrifactions are generally composed are calcareous, siliceous, or argillaceous, in

different states and differently mixed. Of those that are calcareous, the greater part are carbonates; fluate of lime sometimes serves as a matrix, but it rarely forms the substance of the fossil. Sulphate of lime sometimes lines the cavities left by destroyed fossils, but does not itself form them. Sulphate of barytes hardly ever forms the fossils. The matrix of fossils is often silex, quartz, agate, calcedony, jasper, pitchstone, semi-opal, and alumina; the latter substance often enters into the composition of the fossils. Bituminous slate and the argillaceous iron-ores are often fossiliferous. Sometimes, but very rarely, fossils are found in Fuller's-earth. It is said that hornblende sometimes forms the nucleus of fossil shells, and that fossil animals and vegetables have been discovered in substances which have been mentioned as basalts, wackés and trapps.

Of the metals which contribute to the formation of fossils, the most common are iron and copper, rarely lead or zinc, and still more rarely silver; they are generally carbonates or sulphurets. The carbonates and sulphurets of iron are most common in fossil vegetables; the specimens of wood mineralized by copper often possess a degree of beauty which renders them desirable, by reason of the brilliant colour which the malachite communicates to them. Sulphuret of lead has been found in petrified wood: Blende or sulphuret of zinc has sometimes been found, with crystals of quartz, in the interior of fossil shells; it is even said that silver forms a fossil resembling an ear of wheat in the mines of Frankenberg in Hessia.*

Incrustations are formed by a deposition of stony matter, and when this covers organic bodies all over, but thinly, the forms are preserved, and the substance in some cases appears as if really petrified: these incrustations are sometimes siliceous, but more frequently they are calcareous.

Casts.—Whenever an organic body is enveloped in a pasty mass which subsequently hardens, if anything causes the destruction of the enclosed body a cavity or mould is the result; if now any substance enters the cavity so as to fill it, and then hardens, a re-integration of the form of the organic body will be effected, and such pseudomorphous formation is called a Cast; it being, in fact, produced by nature in a way similar to that of forming casts by art. These

* Parkinson's Introduction to the Study of Fossil Remains. London, 1822.

casts may be either of the same substance with the mould, or of a different substance; in the former case, they are regarded as nearly contemporary with the formation of the mould, and in the latter case as more modern.

Impressions.—Flowers, leaves, the wings of insects, &c., are too delicate long to resist total decomposition; they, however, leave their impressions, which are frequently found in certain slates, indurated clays, argillaceous iron-stones, tufas, &c.

There is another kind of impression which is very interesting, it is the marks or prints of the footsteps of certain animals. The creatures which have thus left traces of their passage, must have walked over the rock when it was in a soft state, so as to receive and retain the marks of their feet; the rock has next become indurated and has subsequently been covered with fresh accumulation of sedimentary matter, so as to hide these impressions till accident brings them to light by the splitting of the stone.

Fossils have been found at great depths below the soil of the lowest plains, and in rocks at very great elevations above the present level of the sea. They consist exclusively, except in extraordinary cases, of the osseous and horny parts of animals, such as bones, teeth, horns, hoofs, &c., the tests of crabs, the scales of fish, the caustaceous elytra of coleopterous insects, &c. But of all fossils, shells are the most abundant and the most perfectly preserved. Human bones have been found only in one or two places, embedded in a rock of very modern formation. Some elephants and other animals have been found with all their flesh still fresh upon the bones, though dead for centuries; but these have been embedded in ice which has secured them from decomposition.

Fossil vegetables are the most abundant of any if we are to regard coal and lignite as such; but, independent of these, which seem to be a formation *sui generis*, whole trees are occasionally found converted into silex or lime, and yet retaining all the essential features of their organization. Nuts, cones of firs, reeds, &c., are occasionally found petrified, and sometimes converted into pyrites. Among vegetable impressions those of ferns are perhaps the most abundant. Fossil bodies appear to ascend in the scale of organization as the rocks and formations in which they are found become more modern, and while the older strata contain the remains of organized beings the like of which no

longer exist on the surface of the earth; higher up in the series are found, with the remains of extinct races, a few of such as are still living in some parts of the world; and, finally, we meet with a number of fossils exactly similar to animals living in the country, or to the fish or shells still found in the adjacent seas.

SECTION II.

VEGETABLE PRODUCTIONS.

The consideration of the Vegetable Productions of a country is so essentially connected with what regards its agriculture, that it is hardly possible to separate the two objects without leaving each of them imperfect, or running the risk of useless repetitions. We shall therefore treat of the vegetable productions of a country, in the section on Agricultural Industry.

SECTION III.

ANIMAL PRODUCTIONS, OR ZOOLOGY OF A COUNTRY.

There are two ways in which the Animals of a Country may be considered. They may be regarded generally as objects of Natural History, and arranged according to some particular system, or they may be considered as a branch of statistical inquiry, and arranged according to their respective importance. We shall point out the observations to be made in both cases.

OF THE ANIMALS OF A COUNTRY CONSIDERED AS OBJECTS OF NATURAL HISTORY. In considering the animals of any particular country, the traveller must distinguish such as are common to it and other countries, from such as are peculiar.

Of those that are common, he should attentively observe their comparative abundance or scarcity, and what, if any, difference exists in size, colour, habits, &c., between those of the country under examination, and the same animals in other countries.

Of the animals peculiar to the country, he must distinguish the well-known from those that have been but imperfectly described, or are altogether unknown, and endeavour to describe the two latter as correctly as possible.

The Zoologist will, of course, arrange the animals of the country according to a system, probably that of Linnæus or of Cuvier, and he well knows, without any hint from us, what are the particulars he should observe, in order to determine the place in the system which any animal should occupy, and how to describe any new or imperfectly known individual he may meet with. But, for the traveller not versed in Zoology, it may be well to point out in a popular way, the observations he should make, in order to give as correct an idea as possible of the animals he may wish to describe; and as the more scientific classifications could not be appreciated by him, he may adopt the following :—

1. Quadrumanes.
2. Viviparous quadrupeds.
3. Cetaceous animals.
4. Birds.
5. Oviparous quadrupeds.
6. Serpents.
7. Fish.
8. Moluscous animals.
9. Worms.
10. Crustaceous animals.
11. Insects, including Arachnides, or Spiders.

QUADRUMANES.—Observe particularly the size of the animal, the form of the head and the facial angle, the dimensions of the forehead, the colour of the uncovered skin of the face and hands, the number, size, form, and setting of the incisive, canine and molary teeth, the length of the arms and hands, and freedom of the thumbs, the colour and kind of hair or wool, on different parts of the body, the callosities and uncovered parts of the body, and whether the animal be with or without a tail; if it has a tail, what are its dimensions, is it wholly, or in part only, covered with hair; is it, or is it not prehensile? Is the animal slow or agile in its motions; mild or savage in disposition? What

is its food, and what are its habits? What is the difference between the male and female, between the young and the adult, &c. &c.?

VIVIPAROUS QUADRUPEDS.—Observe their size, that is, their height in general and their length, exclusive of the tail. Is there any difference, and what, between the height of the fore and hind quarters? What is the breadth of the chest and its form? What are the dimensions of the tail, and is it round or flat, bare or covered with hair, similar to, or different from that of the body, or is it covered with scales, or has it any other peculiarity? How is the body covered, is it with hair or scales, or spines, &c., or is it bare? What difference is there in this respect between the back and belly, the head and the tail? What is the length and the form of the neck, is it decorated with a mane? What are the form and dimensions of the head, and how is it carried? Of the ears, what are the kind, dimensions, and situation? Are there any horns or other appendages; if so, of what nature are they, what are their dimensions and situation; do the animals shed them; and if so, at what season? Of the eyes, what are their colour, dimensions, situation, and general expression? What are the form and dimensions of the mouth? Of the teeth, observe their number, nature, dimensions, and form in either jaw; at what age do they come, and when do they fall out? Of the legs, what is their length, colour, and form? Of the feet, what is their form and size; are they covered with a single horny substance or hoof, as in the horse, or are they cloven in two like the cow's, or formed into toes with nails, as in the hippopotamus; are the front and hind feet alike, or is there any, and what difference; are the toes joined by any membrane, or are they quite free?

What difference is there in any, or all of the above particulars, between the male and female, the young, the adult, and the old animal? Life; does the animal bring forth its young indifferently at any time of the year, or only at particular seasons; and if so, when? At what age is the animal considered adult, or as having attained its full growth? At what age does it cease to propagate, and what is the ordinary length of its existence? What is the rutting season, and how long does it last? What is the usual number of young at a birth? How long does the gestation last, and how long are the young suckled?

What are habits, character, sociability, cry, and nourishment of the animal; the mischief which it does, or the

services it renders while alive, though in a savage state? What services are obtained from it by taming, or domestication; what uses are or may be made of parts of its body during its lifetime, or after its death? What are the methods of taking and taming it when wild, or of rearing it if domesticated.

Belonging to Viviparous Quadrupeds are two remarkable kinds, the Marsupial or *pouch* animals, as the Kangaroo and Opossum, and the Amphibious-viviparous quadrupeds, as Seals, Walruses, Beavers, &c. The peculiarities in the conformation and habits of these animals, must be carefully noticed and described.

CETACEOUS ANIMALS.—These are great viviparous marine animals, which are immediately distinguished from fish by the tail being horizontal; they swim slowly, and live in the high seas, which they seldom quit, but at the risk of their lives; they comprise the different kinds of Whales, Dolphins, &c.

Cetaceous animals have a long naked body, that is to say, without scales; they have fleshy fins, without hair, and although by their general appearance and the element they inhabit, they would seem to belong to the class of fishes, they are in reality assimilated to quadrupeds by a stronger and more perfect analogy. They have ears, they breathe like quadrupeds, they have teats below the belly, couple, bring forth their young and suckle them after the manner of quadrupeds. They have two ventricles to the heart, lungs, and are warm-blooded; in a word, they have the organs, the viscera, and the greater part of the bones corresponding with those of quadrupeds.

These animals grow but slowly, and live a long time; the class is not numerous, but as there may yet be some kinds imperfectly described or altogether unknown, we have been induced to give the leading characteristics by which they are distinguished; so that in the event of the traveller meeting with any strange or undescribed marine animal, he may know at once whether it be a fish or a cetaceous animal, and he will proceed to examine and describe each part, and the form and dimensions, &c., of the whole, with as much accuracy as possible.

BIRDS.—With regard to birds, the following are the observations to be made:—In the first place, give the name and the detailed description of all their parts and their physical properties; as the colour, form, and dimensions

of the head, of the body, of the wings, of the tail, of the legs and feet, the beak, the eyes, the feathers, the claws, the particular appendages, &c. Do they inhabit the country throughout the year, or are they birds of passage ; and if so, when and from what quarter do they arrive, from what country are they supposed to come, and whither do they go ; how long do they remain ; and do they arrive and depart regularly, singly, or in flocks ? Whether of passage or not, are they scarce or common ; what is their food, and how do they procure it, (the graminivorous are the most easily transported and naturalized in different climates,) what difference of size and plumage distinguishes the male from the female, the young from the full-grown birds ? Do they moult more than once in the year ; what is the moulting season ; do they change colour at different times of the year, which is not uncommon between the tropics ; do they lay eggs at all times of the year, or only at some particular season, and which ? How many hatches of eggs does the hen lay, and how many eggs at a time ? what is the form, size, colour, and weight of the eggs, how long does incubation last ; how and with what are the nests made, and where are they placed ? Does the female alone build the nest, or does the male assist in the operation ; does he share with his mate the labour of rearing the young ? How long is it from the hatching till the birds can fly ; do they remain long together, and when do they disperse ? Of what use are they, or what mischief do they do ? How are they taken, if wild ; what care is taken of them, if domestic ? What is their cry, their habits, &c. ? In a word, nothing should be omitted in order to give as perfect a description as possible.

OVIPAROUS QUADRUPEDS, as the name implies, are animals produced from eggs, and having four feet : this Class comprises Tortoises and Turtles, Crocodiles and Lizards, Frogs and Toads, &c.

As for *Tortoises* there is considerable variety among them, Daubenton gives a list of fifteen varieties. Lacepede makes out twenty-four. Cuvier describes fourteen varieties contained in five orders, viz. : 1, land tortoises ; 2, freshwater tortoises ; 3, sea tortoises or turtles ; 4, the *tortue à gueule*, or beakless tortoise ; and 5, the soft-shelled tortoise.

The males in all the species are distinguished from the females by the flatness, or even concavity of the lower shell or *plastroon.*

The following are the objects to be attended to in describing tortoises.

The general dimensions and form of the animal. The degree of convexity of the carapace or upper shell, and its strength; has the animal the faculty of causing his shell to collapse wholly or in part? What is the form, number, and arrangement of the scales or plates by which the carapace is covered; their superficial dimensions, thickness, consistence, colour and disposition of colour, and their surface, which is either smooth, rough, grooved or ribbed, or marginated? (Some have no scales at all, their place being supplied by a kind of hide.) Are the pieces of the under shell contiguous, or separated by a cartilage, and at what distance? As to the head in particular: what are its dimensions in different directions, and its general form, particularly that of the mouth, which in some species, resembles the beak of a parrot? The general form of the head is not unlike that of a serpent. What is the form and position of the nostrils; how are the eyes, the lips, and jaws? the latter, instead of teeth, are garnished with a horny ridge, and sometimes are merely covered with a skin. What is the length of the neck and kind of skin with which it and the head are covered?

As for the feet, they have been chosen by M. Lacepede as a character for making two divisions of tortoises; the first, comprising those which have their toes very unequal, and lengthened into the form of fins or paddles; and the second, those which have very short toes, and these nearly equal. (The fresh-water tortoises have their toes more free than the land-tortoises, and, in some varieties, a kind of membrane unites them.) These differences must therefore be noticed, as also the number of toes on the fore and hind feet, with the number, form, length and colour of the nails. In sea-tortoises, the skin near the legs is generally covered with scales. Obverse of the tail, what are its dimensions and form, and how it is covered. Some tortoises can draw in their head and limbs entirely, others only partially.

Care must also be taken to note whether the animal described, lives only on land, or in the water, or is amphibious; the situations where it is usually found, where it lays its eggs, and in what number, and how long before these are hatched; what it feeds on, its general habits, usual length of life, &c.

Some tortoises are very large, some very small. The plates of some are valuable in the arts, others are of no use; the flesh of some is a delicious food, that of others not eatable, though the eggs may be delicate eating.

Crocodiles, Alligators, Lizards, Chameleons, &c., are all allied to the lizard tribe, and are united under the general name of *Sauriens,* they are arranged by Cuvier into six families.

Wherever the traveller meets with reptiles of this kind, he should examine them very carefully, as their arrangement in the system depends upon circumstances, not at first striking. Thus must be noticed—

The dimensions of the animal and its general form; the form of the head, and every thing belonging to it, as the scales or skin by which it is covered, the ears, the eyes, and number of eyelids, (frequently three,) and the way these open; the number, arrangement, form, and size of the teeth; whether only one or two upper rows; if any, and which of the lower teeth, when the mouth is closed are received into alveoles or cavities in the upper jaw; the form and nature of the tongue, and whether or not it may be darted forward; how many toes there are on the fore and hind feet; whether these toes are regular or irregular in length, free or connected wholly or in part by a membrane; whether or not they are divided into two sets, as it were; for in some kinds, having five toes, they are so divided as that two are separated from the other three. Are any of the joints of the toes flattened out into discs, and which; how many and which toes have nails; and what is the form and nature of these claws, and how are they set; are they visible or concealed? are there any pores under the thighs or near the arms? What is the length and form of the tail; is it prehensile or not? What is the number of rows of scales; are these rows transversal or longitudinal? What is the shape of these scales and the way they are set; do they cover all parts of the body and limbs, or only the former, and the latter not at all or partially? Are the scales raised into one or more ridges of protuberances or serrated edges along the back and tail? What is the colour of the animal? In the chameleon and other varieties the colour changes. Is there any goiterous swelling at the throat? Are the ribs directed straight out, stretching the skin into a sort of wings, as in the Dragons, &c.? Some reptiles ranged along with lizards, though forming a kind

of transition between them and serpents, have but two hind legs, and others only two fore legs.

Some of the Saurien tribe inhabit exclusively the water, others the land, and some are amphibious; some live principally on trees, some in sandy places, others in old walls; some in marshes; some cast their skins: some are extremely small, and others, as the crocodile, of immense size. The flesh of some is reckoned delicate, and the eggs of others are eaten; some are considered venomous. Independent of these observations, attention should be paid to any difference from age or sex, and the habits and manners of the animals must always be noticed as far as possible.

Frogs and Toads. — These reptiles differ but little in their general character; the body of the frog is more taper and angular; that of the toad, rounder and more clumsy; the body of the frog moreover is smooth, that of the toad covered with tubercles, whence there arises a fetid humour; the frog is more agile in his movements than the toad; and whereas the former is fond of the water, in which he swims well, the latter generally lives retired from it; the frog has its upper jaw furnished with fine teeth, besides an interrupted transversal row of the same in the middle of the palate; the toad has no teeth. All frogs have the hind feet long and web-footed; with toads, some have their hind feet perfectly webbed; others, imperfectly so, and some not at all.

There is a kind of frog known by the name of the *tree frog*, which has the extremity of its toes spread out into vesquous puffs, by which it is enabled to climb upon, and attach itself to, trees, &c.

There is, moreover, a reptile which, though arranged with frogs and toads, is distinguished from them by a flat body, a large triangular head, and no tongue, the toes of its front feet are each divided into four small points; its habits are remarkable.

Of frogs and toads, therefore, the traveller will observe their size and form generally, and all their parts in detail, together with their colour (in some this is different according as the animal sleeps or is awake, is in the sun or the shade); smell (some varieties emit very strong, and fetid odours); their motion, whether leaping or crawling; their habits, their cry or croak, &c.

Some frogs are eaten, and even some toads. The spawn of these animals is also worthy of notice; in some kinds it lies in heaps, in others, in long trains, double or single, &c.

The tadpole state of frogs and toads, and the time these reptiles retain this form, should also be noticed.

SERPENTS OR OPHIDIA.—This class of reptiles is very numerous, and there are doubtless many yet undescribed varieties. It therefore behoves the traveller, when he cannot preserve the individuals in spirits or otherwise, to examine them attentively, in order to give as perfect a description as possible. The following circumstances must therefore be attended to:—

The dimensions and form of the animal, and of all its parts. Are the jaws extensible or not? which in many kinds they are by means of ligaments; the palate in some is also dilatable, which structures enable the reptiles to swallow large bodies. What is the number, arrangement, and form of the maxillary and palatine teeth? Observe the fangs or poison-teeth, the only maxillary ones in venomous serpents; the expansibility of the neck, the form and degree of extensibility of the tongue; the form of the tail, and whether prehensile or not. Are there any appendages, as horns, on the top of the muzzle or on the eyelids? Besides which observations, the greatest attention must be paid to the scales, plates, and rings of these reptiles; the number, form, and relative size of these on the different parts of the body, and their size; are they carinated or tubercular, and how are they set and arranged; are there any outer rings, where, in what number, and of what size? What are the colours of the animal, and how are these distributed? In the case of rattlesnakes, how many articulations are there in the tail?

Remember that some serpents have no scales at all, but, on the contrary, a smooth skin, plaited on the sides.

Is the reptile viviparous or oviparous; venomous or not? How often, and when, does it cast its skin? when, and for how long, does it remain in a torpid state? Is it aquatic or amphibious, or does it live only on the land? Where does it usually hide; in dry sandy places, in the grass, &c., in holes, or at the surface? Does it ascend trees? What is its prey, its habits, its noise, &c.? Is it eaten?

FISH are, perhaps, of all animals, the most varied, and, consequently, the most difficult to classify; it cannot, therefore, be expected that any but a consummate ichthyologist will attempt to classify the fish he may procure or see; but every observer may and should describe them as accurately as he can; and for this purpose he will state, first, whether

if it be a salt or fresh-water fish, and, if the latter, whether it inhabit running or standing water; after which he will proceed in his examination.

What is the general form, the dimensions, and weight? *Head,*—its form and size. *Eyes,*—their colour, form, dimensions, and situation. *Nostrils,*—situation and form. *Mouth,*—dimensions, form, and situation. *Teeth,*—these may be set in a great variety of positions, as in the jaw, along the bony arcs of the gills, on the palate, the tongue, &c.; their form and number are also very various. *Tongue,*—is generally bony, and covered with a hard substance, or set with teeth. *Ears,*—situation and appearance. *Body,*—its form and dimensions. *Scales,*—some fish have none; but of those that have scales, what are their form, size, and nature; how are they disposed and set; is all the body covered with them, or only in part; are the scales grooved, and how; fringed or otherwise? Are there any spines, tubercles, &c., on the body; and, if so, of what kind are these? How is the fish painted, that is, what are its colours, and how are they disposed? *Tail,*—what is the form, colour, and consistence of the tail? *Fins,*—of these the *dorsal* are set on the back, and are from one to four in number; the *pectoral* or breast-fins are always two; they are sometimes lengthened out so as to answer the purposes of wings, as in the flying fish; the *ventral* or *abdominal* are placed under the throat or belly; these are sometimes united into a disc or sucker; the *anal* are under the tail, and are in number from one to three; the *caudal* is the tail-fin. The fins vary considerably, having bony, or cartilaginous, or membranous rays, which are united by an intermediate membrane, itself differing in texture in different fish. In some fish some of the rays are bony, and others cartilaginous; in others the rays are continued to some length beyond the margin of the fin, in the form of sharp spines. All these circumstances, then, must be noticed, as also the particular form, size, precise position, texture, and colour of the fins; the fins are sometimes, as in the shark, &c., covered with the same thick skin as that of the body; they have sometimes peculiar appendages, and in a particular fish, the Climbing Perch, they are such as to enable the animal to climb trees.

Some fish exude a venomous fluid from the pores of the skin, and some have the very remarkable property of giving electrical shocks, &c.

To the above observations it will be well to add, if it be a sea-fish, at what distance from the coast it is found; whether it be abundant or rare; what are its manners and habits, and its prey; its season of spawning, &c. If eaten, its quality and flavour; if it be taken for any particular uses, to which parts of it are applied, what are those parts, and their uses, and how is the fish taken?

MOLLUSCA.—These animals, which form the second grand division of Cuvier's system, are of two kinds: the naked, and the shelled or testaceous. The animals themselves are of so peculiar a structure, and their classification depends upon such a perfect knowledge of their anatomy, and examination of their several parts, and the functions of these, that none but a naturalist can attempt to arrange the Mollusca systematically, or even describe them. The shells or tests, however, of such as are so provided may be described, or, what is still better, may be easily collected and preserved.

The study of shells, or Conchology, is particularly interesting, by reason of the beauty of the objects themselves, and because, of late years, it has become important, in a geological point of view, to compare the recent with the fossil shells.

Before speaking exclusively of shells, however, we will merely remind the traveller, that, without attempting to describe the mollusca, he may notice the following objects respecting them generally:—

Whether they are naked or testaceous; where found, on the land, in moist or dry places, on plants generally, or on particular kinds, and which; in the sea, at great depths or near the margin; in the mud or sand, or adhering to, or penetrating wood, stone, madrepores, &c.; in fresh water, running or stagnant; their abundance or scarcity at all times, or at particular seasons. Are they injurious, as the garden snails, slugs, the ship-worms, &c.; or useful in any particular way, as the cuttle-fish for its bone and colouring matter, the mother-of-pearl shell and pearl-oyster, the *Pinna nobilis* for its byssus, the cowry used as money, the *Tradescans* as dishes, &c. What does the animal feed on; is it itself eaten as common food or as a delicacy, as the oyster, mussel, periwinkle, snail, &c.?

Shells.—The greater part, perhaps, of those now existing are known, so that the traveller need not trouble himself to describe them; it will be sufficient if he collect them and bring or send them home; nevertheless, as there may be

some testacea which inhabit great depths, and which are so rarely cast up as to be as yet unnoticed, and as the traveller may not always be able to collect and preserve, though he may have leisure to examine and make notes, we will here remind him of the various details regarding shells. To describe minutely all the several parts would exceed our limits; we shall, therefore, just mention the principal, in order that none of these may escape the notice of the observer. If he do not know them he will do well to study them, which he may from any work on the subject, or from the examination of collections.

Shells are either *marine*, i. e., littoral or deep-sea; *fresh-water*, fluviatile, or lacustrine; or *land-shells*. Marine shells are either *univalve*, *bivalve*, or *multivalve;* fresh-water shells are univalve and bivalve; and land-shells (living ones) are exclusively univalve; all other kinds, when found on land, are dead, and either lying loose or at the surface in alluvial soils, or imbedded, and in that state are properly called fossils.

Univalve shells are the most numerous:—Observe the *Apex*, which may be either prominent and sharp, or blunt or depressed, or even have a hollow in it like an *umbellicus;* the *Base*,—how is it formed? The *Body*,—its relative size and form? how is the *Front*, the *Back*, the *Belly*, and the *Sides?* (remember, that when a univalve shell is viewed in front, the *right* side is the side next the observer's *left* hand.) *Aperture*,—its form and dimensions, particularly as on this depends principally the distinction of univalve shells; *Canal*,—some shells have two; *Beak*, *Pillar*, or *Columella*,—this being internal, nothing is seen of it but the inner side of its base, which is frequently grooved or plaited; *Pillar* or *Inner lip*,—the glossy *process* with which the aperture is lined and expanded on the Columella; *Outer lip*,—a similar expansion on the opposite or left margin of the aperture; *Operculum* or *Lid*,—is either testaceous or cartilaginous; *Spire*,—all the whorls of the shell together, except the lower, which is the *Body;* the spire is elevated or depressed, or involuted, as in the Nautili, and has more or less whorls, but this often depends on the age of the shell. A completely-formed outer lip is the sure criterion of a full-grown shell. *Whorls*,—the revolutions of the shell. The *Suture* of the spire or whorls is the spiral line, separating the wreaths or whorls from each other; it is sometimes crenated, undulated, or sulcated,

and not unfrequently elevated or projecting. When the spire runs upwards from right to left, or the reverse of a common corkscrew, the spire or shell is said to be *reversed.* The *Chambers* are the separate cavities of the interior; they may be regular or irregular. *Umbilicus,*—circular perforations sometimes confined to the base of univalve shells, and sometimes passing up, and diminishing from the base to the apex; when this opening is partially covered, the shell is said to be sub-umbilicated. Shells with no umbilicus are termed *imperforate.* *Siphunculus,*—is the small round perforation which forms a communication between the chambers of the *Nautili; Varices,*—are transverse ribs crossing the whorls of the shell; they are the margins of the outer lips, and point out the periodical enlargement of these shells; *Ribs,*—are longitudinal and transverse protuberances; *Teeth,*—in univalve shells, are the terminal sections of spiral laminæ or ridges running backwards; *Epidermis,*—is the external membranous covering observed on many shells; its nature is very different in different species.

BIVALVE SHELLS.—The valves may be equal and similar or the reverse: in contour they may be equilateral or inequilateral. The *Base,* according to some authors, is where the hinge is placed, and the summit the opposite end, and according to others, the very reverse of this; *Sides,*—are the parts right and left. The *anterior slope* is that part of the shell next you when held in such a way that the *beak* retires from view. The *posterior slope* is the opposite of this, or that in the direction of the *beak.* The *Disc* is the convex surface of a valve. The *Lunules* are lunated depressions in the anterior and posterior slopes; *Ligament perforation,*—is the opening for the passage of the ligament, by which the animal attaches itself to stones, &c.; *Hinge,* is the point at which the valves are united, and on which they open; the hinge, with its teeth and their opposite sockets, are most important parts of bivalve shells, for on these their general character is founded. The number, situation, size, form, and arrangement of the teeth should therefore be carefully noted; some shells have no visible teeth, and are then called *inarticulate.* The teeth are primary, or cardinal, or middle, lateral, double, incurved or recurved; *Cavity of the hinge,*—is the hollow depression for the *ligament* which is the uniting cartilage. The *Beak,* is the extreme point near the hinge. The *Seam,*—the line of separation between the

valves when these are closed; *Ears*,—the processes on each side of the beak; *Margin*,—the extreme edge of the whole shell; this is either entire or crenulated, &c.; *Striæ*, fine thread-like lines on the exterior surface of the shells, these are sometimes both longitudinal and transverse. Some shells have their inside striated. The *Right valve*,—according to Brown, is that valve which, when viewed with the inside uppermost, has the anterior slope pointing to the right hand; the left valve is of course the reverse. The *length* of a shell is taken from the ligament or the beak to the opposite margin; the breadth is taken from the extreme edge of the anterior and posterior slopes. The *Byssus* or beard is a kind of fibrous or long appendage composed of filaments of a more or less silky nature, by which the bivalves fasten themselves to their beds.

Multivalve Shells are composed of several, generally eight valves, having an *operculum* of four pieces, a ligament or ligaments by which the different parts of the shell are attached, a peduncle by which the animal adheres to wood, &c.

There are besides these a variety of names and terms necessary in the description of shells, but we cannot here give a complete glossary, and have done sufficient to remind the traveller of the various parts that must fix his attention; besides which, he should state what are the size and dimensions of the shell, its colours and shades, and their arrangement, as in spots, or bands, or stripes, straight or zigzagged, &c. Whether the surface of the shell be smooth, or ribbed, or grooved, longitudinally or transversely. Whether they have spines or tubercles, &c.

WORMS.—These are the *Annelides* of Cuvier, and constitute his first class of articulated animals. There is a great variety of worms: some form tubes to live in; others do not make tubes, but are covered with scales, and many are quite free from all hard covering. The tubes are found either adhering throughout to stones or shells, or coral in the sea, or to rocks on the shore, or they are merely attached by one extremity, or finally, they are free. The form and nature of the tubes vary considerably; some are contorted in all kind of ways, and others are more or less straight; some are large, others small; some are round in their section, others angular; some are smooth and calcareous, others are rough and formed of clay, of sand, of broken shells, &c. Of those that do not form tubes, some live in holes in rocks,

or in old wood; others in mud, in the sand, &c. Most worms are aquatic, some living in the sea, others in fresh-water; but some are land-animals. Of the aquatic worms one at least is valuable, the leech. Of the land kind the common earth-worm is universally known; some of those which live in the sands of the beach are much sought for by fishermen as bait. Some of the annelides are very beautiful; some are exceedingly small, and some are very large. All the traveller can do with regard to this class of animals is, to collect and preserve them in the manner most suited to their nature, and to give the best possible account he can of their abundance or scarcity, at all times, or at particular seasons, as also of their manners and habits, of the mischief they do, or of the uses made of them.

According to the popular meaning of the word *worm*, these animals may be said to inhabit the bodies of other animals, and may be found in all kinds of vegetables, and even living in man; but many crawling things are taken for worms, which in reality belong to quite different classes of animals.

CRUSTACEOUS ANIMALS.—Of these there are several kinds, the principal of which are generally known as affording a delicate food, viz., Crabs, Lobsters, Crawfish, Prawns, and Shrimps.

Some of the *Crustacea* live on land, some in salt-water, others in fresh, and some are amphibious. Of those that are common and known, the traveller will only speak as to their abundance, size, particularities, if any, &c. Of those used as food, he will state the quantity annually taken, and their value, the modes of taking them, &c. Of the little known or new varieties, he will, if possible, take individuals, stating particularly every thing regarding them, such as the places whence taken, the season, the abundance or rarity, &c.; as also the uses to which they are or may be applied, and whether venomous or otherwise hurtful, &c.

INSECTS, including spiders, scorpions, &c.—Spiders, Scorpions, and a few others, are by Cuvier separated from insects, but in a popular view of the subject they may be regarded as insects, though vulgarly scorpions are considered reptiles. All the animals which we here include under the general denomination of *insects*, are not only more or less complicated in their organization, but many are very minute. A few of the more common only, and such as are remarkable for beauty, are noticed by the many, so that none but

professed entomologists can attempt to classify, or even minutely describe them.

We may observe generally, however, that of insects, some are aquatic, some terrestrial, and some amphibious; some again are aquatic during one period of their existence, and terrestrial, or rather aërial, afterwards, being constantly on the wing. The determination of insects, in consequence of the metamorphoses which most of them undergo, cannot be effected till after their last change, for then only can they be regarded as perfectly developed.

Of perfectly known insects, it may be sufficient for the traveller to mention them, together with any thing he may observe or ascertain regarding them; others he should collect; and though he need not attempt any description or classification of them, he should give the fullest information in his power regarding their peculiar habits and manners.

Of spiders, he will observe whether they spin a web or not, and of those which do, he will describe the kind of web, the situation in which it is usually spread, as on the inside or outside of dwellings, in dry places or damp and dark cellars and corners. Of those which spin no web he will take note of the kind of habitation they construct for themselves. In both cases, what is the kind of insect the spider seems to prefer for food, and the way in which the animal attacks, fights with, overcomes and kills its prey. He should also describe the cocoon or egg-bag, state where it is concealed, how constructed, and whether or not removed by the parent in case of danger. Some spiders are particularly venomous; of such it should be stated what is the usual effect of their poison; and how this effect is cured; what is the particular enemy of the spider, and if the latter be generally victorious or vanquished.

Of the remaining innumerable tribe of insects, in like manner, the intelligent traveller will inquire and examine into their manners and habits. He will give the history of their existence from the egg up to the perfect insect, the number and the nature of the changes they undergo, and the times at which these take place; the substances in or on which the eggs are deposited; the kind of food exclusively chosen or preferred by the insect in the different states of its existence. If it preys upon other insects, how it entraps, attacks, and kills them; whether it devours the whole, or merely sucks the juices. To what animals is it in its turn

a prey. Is it solitary or gregarious; is it injurious, and if so, how; is it useful, and if so, in what way, naturally or by reason of any particular purposes to which it is applied by man? Bees would be an example of the naturally useful, and the Kermes or Cochineal insect an example of applied utility.

To go into further detail on this subject would be superfluous: every well-authenticated fact is useful to science, and no fact should be regarded by the traveller as unworthy of his notice.

Finally, on the subject of the zoology of a country generally, we would recommend to the traveller, particularly if pressed for time, to devote his attention most exclusively to those animals which are of the greatest importance in each separate class; and if he should be so fortunate as to make the discovery of any useful application of any animal or animal production, he should not fail to enter into all the details which the importance of the subject may require. We will now pass on to the observations to be made on animals statistically considered.

ANIMALS CONSIDERED STATISTICALLY, OR ANIMAL RICHES OF A COUNTRY.

Many animals are superior to the human race in bodily powers; thus some are remarkable for strength, others for agility, speed, power of vision, &c.; but man, pre-eminent over all by the extent of his intelligence, has learned to apply to his own purposes the peculiar faculties of each; nay more, he strips several to clothe himself, he feeds on the flesh of some, and extracts medicines from others: in a word, he has made the whole animal creation subservient to himself, whether it be for his labours, his subsistence, his health, or his pleasures. Some serve him while living, others are of no account till dead, and many are a source of profit both when living and after death.

Thus the animals of a country form an important part of its wealth, and as such, deserve particular notice. The mode of arranging them in a statistical point of view is very different from that of a zoological classification. We have already spoken of the latter, and shall, therefore, now proceed to treat of animals and animal productions as part of the national wealth.

Very generally we speak of domestic animals as if they

were a distinct class. It is true certain animals are naturally much better disposed to acquire domestic habits than others, indeed, it is probable that the Supreme Wisdom has specially endowed with domestic propensities those animals that are most useful to man ; but we must consider also that the *seal*, for instance, fully as susceptible of domestication as the dog, has never been considered a domestic animal ; while, on the other hand again, the elephant, which has as good a right as the horse to be called domestic, does not reproduce in a state of domesticity. The cat, essentially domestic, belongs, in fact, to the race of tigers, the most undomesticable of animals; moreover, it may be remarked that in the beginning all animals are wild, that several kinds, wild in one country, are domestic in another, and that in some cases we find them in both states in the same country.

From these considerations it follows, that the term *domestic animals* does not designate any distinct race of animals, but rather a particular state of certain animals, and that consequently it were more correct to call such as are in that state *domesticated* animals. Nevertheless since use has consecrated the term domestic, we shall continue to use it, extending its application to all domesticated animals, to the rein-deer of Lapland, the elephant and the camels of Asia and Africa, the Llamas of America, as well as to the horse and ox of Europe.

We beg pardon of such of our readers as may consider this a useless digression, but we are sticklers for propriety of terms.

Domestic animals are confined to a few viviparous quadrupeds, and a few birds. We find none among the other classes ; it is true fish are kept in reservoirs, and even frogs and snails are reared in certain countries; but they are kept prisoners, like the lion in his cage, and have no more domestic habits than he has. Some Hindoos feed Serpents and Turtles; but these creatures thus partially tamed, whose numbers, moreover, are very limited, come only at their meal-times and remain at liberty. We collect together a quantity of bees in hives, of silk-worms under sheds, and of cochineal insects in plantations of the Cactus, &c., yet none of these animals are considered domestic.

But if among all the classes of animals two alone furnish us with domestic ones, it by no means follows that all the rest are without utility to man; on the contrary, he derives profit from a great many of all classes. We must, therefore,

take into account all such as are useful, and we shall accordingly divide the animal wealth of a country (omitting for the present any wrought produce) into—

1. Domestic animals.
2. Raw animal products.
3. Produce of the fisheries.

As for domestic animals, they should be arranged in a tabular form, suppressing or adding the names of animals as occasion may require. Such a table would show at once the annual quantity and value of the domestic animals of the country, together with the proportion employed in agriculture, and for the supply of the cities and town; and, if any be exported, the quantity so disposed of. Some of the data of the table may be made out from the rest. Thus, what is annually exported must be replaced, as also all casualties be supplied; and knowing how long the animals usually live, and at what age they begin to be employed, &c., an approximative, though sufficiently exact, estimate may be made of what the country must annually produce over the numbers employed to keep up the supply.

The observations to be made on the methods of rearing and keeping domestic animals will be found stated under the head AGRICULTURAL INDUSTRY. As for raw animal products, we must remark that, strictly speaking, this term should be confined to such products only as have undergone no kind of preparation or manipulation; but if so limited, the list of objects usually designated as raw produce would be greatly diminished: besides it must be remembered that every workman regards as raw material the objects he is to work up, although they may have already received many modifications from art. We would, however, confine the term to those objects only that have received no kind of manipulation, or one so slight as to be unworthy of consideration.

In order to point out the quantity and value of raw animal productions furnished by the country, another table should be made out, adding or suppressing articles as may be necessary.

The Fisheries are an object of the greatest importance, whether by reason of the food they afford, or for the objects useful in the arts which are derived from them. Thus they constitute a large *item* in the wealth of a country, and the observations to be made on them will be found immediately after AGRICULTURAL INDUSTRY. At present we speak only of the produce; the quantities, value, and destination of

which should, if possible, be ascertained and specified by the traveller.

GENERAL OBSERVATIONS.—As we shall treat elsewhere of the observations to be made on the modes of collecting, preserving, and improving the animal productions of a country, it only remains for us, in this place, to point out a few general remarks which should be made as to the produce itself; its quality and value being stated in tables such as we have given models of, the traveller should ascertain:—

If the annual productions are sufficient for the wants of the country, or, if any are deficient, and which.

If sufficient attention be paid in the country to this important object; if not, what is the reason, and what might be done?

Have the animal productions generally, or any of them in particular, and which, increased or diminished since a given time, and to what amount; and what has been the cause of these variations? Too much land may sometimes be taken up for pasture, to the detriment of other agricultural produce. What is the consequence where such practice prevails, &c.

DIVISION III.

THE INHABITANTS OF A COUNTRY.

SECTION I.

POPULATION.

Extent of the Population.—The extent of the population is usually considered a criterion of the prosperity of a country. We shall not however stop to discuss the merits of this proposition, observing merely, that it is of great importance for the solution of problems of political economy, to possess correct *data* on all that relates to the population of a country. We shall therefore pass on at once to the enumeration of the remarks that should be made on this subject. What is the actual population, men, women, and children, separately and together?

What is the annual number of births, male, female, and together; the annual number of deaths, male, female, and total, and the number of marriages? What difference is there in these respects between the town and the country, between one town and another, and one part of the country and another?

These data will show the relative proportion of male and female births and deaths, and of the total births to the total deaths. This last proportion taken for a number of years will show whether the population be stationary, or whether it be on the increase or the decline, and to what extent. From the total number of births and marriages, the number of children to a marriage will be easily deduced, if care be taken to distinguish legitimate from illegitimate births; in which case, moreover, an additional datum is furnished from which to form an opinion as to the general morality of the people. When the above distinction is not

made in the register of births it is not easy to discover the number of births to a marriage. A general knowledge of the state of morals may enable us to approximate to the truth by striking off a greater or less number of births as illegitimate. Should infanticide be common, the question becomes still more complicated, and the solution still less certain.

In most civilized countries registers of the progress of population and of the ratio of mortality are kept, both for the town and country. These tables show the local differences and the general result; but all countries do not keep these registers with the same degree of accuracy, and when this is the case it is extremely difficult to arrive at correct information.

When tables are kept, the traveller will do well not only to procure these (they are generally published), but he should ascertain if possible how far they may be depended upon, and by what process the government obtains information on this subject. The best method, unquestionably, is actual enumeration; but this, in very populous states, is not only a difficult but an expensive and tedious process. Another method consists in choosing several villages, circles or districts, in such manner as to have a medium term, independent of the differences occasioned by the peculiar circumstances of different localities, taking an accurate enumeration of the population of these at a given epoch, then, by an examination of the number of births annually, for some years previous to the census, ascertaining the mean annual number, which being divided by the number of inhabitants, will give the proportion of births to the population so much the more correctly as the numbers are greater. This proportion being ascertained, it is easy, from the registered births, throughout the country, to estimate the total population.

It is found by the calculation of probabilities that the first estimate must be made on a number of about a million and a half of inhabitants for a total population of about forty millions, in order to have a sufficient certainty that the errors in determining the population by the number of births will be confined to very narrow limits.

Another important element of statistical inquiry is the proportionate number of individuals of the different ages from 1 to 100 and upwards, as compared with the whole population. Tables of this kind are also published, and answer

many useful purposes, both by themselves and in combination with the tables of which we have already spoken. Thus we see at once from the table the number of males in the country capable of bearing arms; and by comparing the number of persons of marriageable age, with the actual number of married persons, we obtain another element for judging of the social state of the country.

The ratio of mortality in a country is also highly interesting; tables on this subject are constructed, which show how many, out of a given number of children supposed born at the same moment, are living after a certain number of years; the tables extending from 1 to 100 years and upwards. By such a table we see at once at what age mortality or the chance of dying is greatest; the proportionate number of persons that die annually at any given age, &c.

All these tables, in a well-regulated state, should be made out for each province in particular, in order that local differences may be ascertained, and their causes inquired into. But the statistics of population require the addition of many more data than we have here mentioned; for instance, the particular mortality of certain ranks, professions, and callings of men; the density of the population in different districts; the division of the population considered under different points of view, &c., &c. Indeed statistics form not only an extensive but a particular science, the numerous and varied elements of which no traveller can be expected to obtain by cursory observation; many objects, having immediate reference to the subject, will be found in the present volume; but we must now confine ourselves to what more immediately regards the population: upon this subject the traveller should ascertain, as far as he can, the following points:—

Is the population increasing, is it stationary or diminishing, and what is the cause in either case? In the first, is the increase owing to good or improved institutions, to the influx and settlement of strangers, or to laws particularly favourable to population and preventive of emigration? We may here remark that, although an increase of population is regarded as a sign of prosperity, a term may be reached beyond which, increase is productive of inconvenience; the means of subsistence not increasing in the same ratio. The possibility of this, we know, is denied by many, but fact is more convincing than abstract reasoning. A wise government, watching over the prosperity of a nation, will provide

against the danger of over-population; or, if this be impossible, will strenuously encourage a proportionate increase in the means of subsistence, or promote colonization.

If the population be stationary, we must endeavour to find out the reason of this. Is it desirable that this state of things should continue, or that the population should increase or diminish; and in either case, why? Are any steps taken by the government in this matter; and, if so, what are the measures adopted?

If the population decreases, to what may this be attributed? Is it owing to any diminution in the number of births, or to an increased mortality, or to emigration, to famine, &c. If the cause be a diminution in the number of births, is this owing to restrictions imposed on marriage, or does it arise from the want of a sufficiency of food, or from its bad quality; or is the cause to be found in the combined effects of an impoverished trade, and that degree of prudence which prevents men from giving birth to beings who would only increase the numbers of the wretched; or, finally, may it be attributed to an increased number of monks and nuns devoted to celibacy; or to a large army, in which the soldiers do not marry.

If the cause of a diminishing population be increase of mortality, is this owing to any change of climate, or to disease engendered by neglect and want of cleanliness, to the introduction of any epidemic or endemic disease, to the increased prevalence of infanticide, &c.? Wars are also a cause of depopulation, not only by reason of the numbers killed, but by the lack of all those to whom they would have given birth; in some cases thousands are led away captive. Civil war also, if protracted, is a fatal cause of depopulation.

Lastly, Emigration may have greatly thinned the population of a country, and when this is the case, it is essential to ascertain what are the inducements to emigration, and whether it should be stopped or encouraged—Are criminals banished, and is the number great?

Famine has been known to thin a population to great extent, but its effect is only temporary. The population increasing immediately after the introduction of subsistence, though slowly at first. If bad crops are common, what precautions are or might be taken to prevent a recurrence of the evil, or to secure the population from its disastrous effects?

The spontaneous decrease of the population of a country is, generally speaking, as certain a criterion of its decline, as its increase is a proof of its prosperity; but a distinction must be made between an emigration which tends merely to keep the population within its due limits, and an actual falling off in the numbers from the other causes above enumerated.

In a word, whether the population be stationary, increasing, or diminishing, the causes and the effects, together with the measures taken, or which might be taken, in either case, should be carefully noted by the inquiring traveller. It is needless to add, that he should enter into as much detail as possible on all matters connected with this subject.

Division of the Population.—Next to the amount of the population, its composition, division, and distribution, are worthy of observation.

The population may be divided in different ways; as—

1. Into natives and foreigners.
2. According to their religion.
3. According to the language they speak.
4. According to rank, profession, and calling.

The first of these divisions will show the proportion existing between the natives and foreigners. If the number of the latter be considerable, inquiry should be made into the cause of this affluence, and whether, in the actual state of the country, it be an advantage or the contrary, and why.

In countries where religious toleration maintains, there is generally a variety of religions and forms of worship; and as these have great influence on morals and manners, it is useful to know the relative proportions of the different religious persuasions, the peculiarities in the conduct of each, and the effect of the diversity upon the character of the nation as a whole.

The division of the population, according to the language they speak, is hardly necessary but in an extensive empire. In smaller states, however, there is frequently a diversity of languages spoken in different parts. These languages are sometimes essentially different, and point out masses or tribes as belonging originally to different nations. When this is the case, it should be inquired into, and the relative numbers ascertained. The dialects of the same language are sometimes very dissimilar, and should also be noticed as to the number and the particular location of those who speak them.

The division according to rank, professions, and callings, should comprise the number of Nobles, of the *Tiers-état*, and of *Proletarians:* the total number of persons employed and paid by the government for the administration of the country, subdivided into different branches, as Magistracy, Revenue, &c.; the number of the clergy of all denominations, separately and together, noting the number of individuals of both sexes cloistered; the number of the standing army and of the navy, and of foreign troops, if any; the number of independent individuals living on their fortune, without profession or calling of any kind, and retired tradesmen; the number of medical men of different grades; the number of lawyers; the number of merchants, bankers, agents, clerks, and other persons connected immediately with commerce; the number of great manufacturers, of handicraftsmen, of shopkeepers, and retail dealers; the number of agricultural labourers; of persons employed in the fisheries; in commercial navigation; in the working of mines; the number of servants, male and female, separately and together; the number of students in the learned and other particular professions; the number of artists, including architects, sculptors, painters, and musicians; the number of persons employed in teaching the sciences; the number of booksellers and publishers; the number of prisoners; the number of poor men, women, and children provided for; the number of the destitute, &c.

The importance of these data is such, that if they could be all collected, and were sufficiently authentic to be relied upon, they would alone form the perfect picture of the moral and physical state of a country. It cannot be expected that any traveller can collect such data to any extent; but he may, if he reside for a sufficient length of time in any town of moderate population, or in any district, by much pains and inquiry, obtain a great deal of information on the composition of the population of such places. We have, therefore, thought it advisable to point out what it is desirable to know, leaving to him to gain as much information as he can.

Distribution of the Population.—An accurate account of the manner in which the population of a country is distributed over its surface is highly interesting. The peculiar occupations of a people, taken in mass, very much depend upon the geographical situation of a country, its climate, its productions, and its general character; as mountainous, woody, swampy, sandy, &c. Most countries, however, of

any extent, present considerable diversity of surface, and what is true with regard to the influence of the physico-geographical nature of a country in general on the occupations of its inhabitants at large, is equally so with regard to the influence exercised by particular portions of the same country. Nor is it the occupations alone of a people that are thus influenced, but these very occupations, in their turn, have a marked effect on their manners and moral habits.

Everywhere water is essential to the existence and well-being of man; and hence, in countries where rivers are scantily distributed, or where the climate and the nature of the soil be such that only the larger streams contain a sufficiency of good water at all seasons, the population will be found to congregate along the borders of the streams, both for the convenience of the water, and because in such countries, generally, the immediate neighbourhood of the streams are alone productive. Thus, in certain maps, as that of India, for instance, we see the villages so thickly set along the rivers of the Punjaub, that their names can hardly be distinguished, while over other parts of that region scarcely a name is to be found. The plains, unless they are mere deserts or savannahs, are more populous than the mountains, and these are more peopled than the woods: we speak generally, and allude to the plains, the woods, and the mountains of a single country or empire. Certain hordes and small independent republics, for greater security, or for other reasons, may prefer to fix their habitations in the recesses of the woods, or in the mountain fastnesses, rather than to live in the open plains.

From these remarks, the traveller will see that the way in which the population of a country is distributed, is an object worthy of his attention.

The custom is generally to ascertain the number of inhabitants to a square mile. This has certainly the advantage of shewing the density of the population in different districts; but any conclusions as to the well-being of the inhabitants of these districts, and the fertility of the districts themselves, founded upon such data, will often be erroneous. It is customary to regard any district, containing from five to seven hundred souls to the square league, as well peopled: yet this proportion, as in the case of the Indian rivers already mentioned, may be found in a district, the nine-tenths of

which are absolutely uninhabited and uninhabitable, and the very reverse of the comfort and easy maintenance which might be presumed from the extent of population, may in reality be the case. The inhabitants may be labouring under all the inconveniences of a crowded multitude, confined in space, and scantily supplied with nourishment, or dependent for their supplies on other places. On the other hand again, the small number of inhabitants to the square league in any province might lead to the supposition that the difficulty of subsistence was great, and the people labouring under all the inconvenience of widely-scattered and distant habitations; while, in fact, they may be living congregated together in some happy and fertile oases, abundantly supplied with all the necessaries of life, and enjoying all the benefits of easy intercourse.

From these remarks it is evident that to give the number of inhabitants to the square league in any district, or province, or country at large, without stating how many square leagues of such district, &c., are uninhabitable, is to give a kind of information essentially unsatisfactory, unless, indeed, the country be known to be so perfectly peopled, that all the inhabitable spots are located ; in which case the data will show, to a certain extent, the relative fertility or inhabitableness of the several districts. We therefore recommend that whenever the traveller would give the distribution of the population, or its positive density, in different parts of a country, or of the country as a whole, he state, not the number of inhabitants to the square league generally, but to the square league of inhabitable surface.

Finally, we would hint that much of what regards the composition and the territorial distribution of the population of a country may be put into the form of a single table.

MORALS AND MANNERS.—Manners, Customs, Morals and Habits, are terms each of different import ; nevertheless, what each separately implies is so connected with the rest, that the whole should ever be conjointly considered, unless for special objects. The French have a term *mœurs*, which combines the whole, and considered in this connected form, Montesquieu defines them, " the usages which regulate the actions of men, in whatever regards their private conduct."

The origin of these usages is, in many cases, difficult to discover ; but as the industry and wealth of a nation, its

religion, its laws, its climate, &c., are intimately connected with its moral character, the study of these several objects separately and together, seems necessary, not only for a particular acquaintance with each, but in order to have a just idea of their individual and collective influence on each other, and on morals and manners.

Men had usages before they had laws, and these primitive usages generally owe their origin to the climate of a country and to the occupations of its inhabitants. The more uncivilized a people, the closer is the relation between their moral habits and the natural origin of these; the more civilized, on the contrary, so much the more will their habits be found to be modified, and the natural and direct influence of climate and occupation counteracted by extraneous necessities. Hence it is that among savages, the manners and moral habits are simple, and their origin easily discovered; while in civilized countries they are of a complex character, often difficult to understand, frequently contradictory, and their origin obscure. In our European states, the more strictly national moral habits and manners are to be found among the rural population: the peasantry are nearer nature, and less sophisticated than the inhabitants of towns. Civilization, by removing men from the simplicity and purity of nature, tends to corrupt their morals; and as great cities are the centres of civilization, so are they proportionately corrupt: nevertheless, we may glean some notions of the morals of a country even in its cities; for if here they are found to be good, it may be fairly presumed that in the country they are better still.

Considered less, however, in reference to their quality of good or bad, than as regards their peculiarity (for they may be very different though equally good or bad), the national manners and habits of different countries, when equally civilized, are now hardly to be traced but in a few indelible features which no circumstances have had power to change. The great facility afforded in the present day for rapid communication between the several parts of the same country, and between one country and another, has so blended the manners of the whole population, so amalgamated foreign with domestic usages, that all the civilized parts of the world present a family likeness, in which the peculiarities of each are only to be discerned by the closest inspection; and when we have at length discovered the individual

differences in the customs and moral habits of different people, we find that this nationality is less a natural type, than the result of a combination, in which the type itself is hardly perceptible, though its influence may be discerned.

Every epoch of society, says a foreign writer, has its peculiar virtues and vices; and which are found to pervade alike all nations equally advanced in civilization, whatever differences there may be in other respects. This observation is just, but we are not to conclude from it, that the morals and manners of all nations equally civilized, are *exactly* similar; that is, that their virtues and vices display themselves in the same way: for in highly-civilized nations, the elements, whose combination forms the morals and manners of a people, being both extremely multiplied and very various, produce, in connexion with the indestructible influence of locality, shades of difference so much the more marked as this influence of locality is more energetic in its action on temperament and disposition. The people of Great Britain and of France, though equally civilized, are characterized by very decided differences in their manners and moral habits.

Every nation, then, having its peculiarities of morals and manners, more or less discernible, more or less natural or adventitious, it should be the business of the traveller to discover and describe them to the best of his ability. The task is, however, by no means an easy one, and to the difficulties of the subject itself, may be added, the prejudice which too often distorts truth, and the proneness to generalize from insulated facts.

The morals and manners of a people, particularly when of a complex character, must be learned by the observation of the conduct of men in all the several relations of life, public and private; for their public acts, in many cases, are controlled by opinion; the standard of which opinion is the prevailing moral feeling. The principles which actuate men in their private dealings will be generally found to predominate in their institutions, and while the character of these is examined, the customs and usages of private life must be strictly scrutinized, and all the observations made must be as numerous and as diversified as possible.

To enter into all the details of this vast subject would be to write a volume, or swell the present work to an inconve-

nient size; nevertheless, it is of such paramount importance that we would go into it at some length, were it not already treated in a very satisfactory manner by an author of acknowledged ability, Miss Martineau, who, in her book on "Morals and Manners," gives the fullest instructions for the way in which these should be observed. To that work, therefore, we refer the reader, contenting ourselves, in this place, with stating briefly a few questions for the traveller's consideration.

Are the inhabitants generally an imaginative or a reflecting people? Are they lively or phlegmatic? Are they distinguished by any particular virtues or vices, and what are these? Are they brave or cowardly; proud or modest; hospitable or inimical to strangers; cruel or humane; confiding or distrustful; witty or obtuse. Are they peaceable or warlike; patriotic or cosmopolite; industrious or idle; sober or debauched; frank or deceitful; religious or profane; liberal or parsimonious; honest or thievish, &c.?

The inquirer should also ascertain whether the present moral character of the people results more immediately from the influence of soil and climate, which determining the nature of their food, and their physical constitution, modifies their disposition, or from the laws, the religion, the industry or the wealth of the nation individually or collectively; and in either case, in what way the cause operates. In like manner it should be ascertained how far the native, or primitively national character has been modified by the introduction of foreign manners and morals, and in what circumstances the essentially native character is most discernible.

In some countries a great disparity may exist between the morals and manners of the people and their institutions; where this is the case, what reason can be assigned for this anomaly, and how might that harmony between them be effected, without which a people cannot long be happy or prosperous?

PHYSICAL CONSTITUTION.—Climate, we have said, has great influence over the moral character; but its effects on the physical constitution of a people is much more evident, as it is more direct. It is a recognised fact, that temperate climates are the best suited to the perfect development of the physical powers of man, and that in proportion as we quit those favoured zones, where a congenial temperature gives the most perfect tone to the body, and enter upon the

equatorial or polar regions, we find either that the too great heat of the former enervates, or that the icy breath of the latter impedes the vital functions. There are, however, many intermediate gradations between these extremes, and that not only in countries situated under different latitudes, but in different parts of the same country.

We shall not enter into the details of the various effects which different climates and localities have on the physical constitution of man, and their several modes of action; it is for experience, study, and sagacity, to discover and explain them; but we would remark that, besides the direct influence of climate, the soil, the food, the manner of living, all tend collectively to form the physical constitution; which constitution the traveller must describe, endeavouring at the same time to explain its cause.

It is not our province to enter into discussions of any kind, and therefore, without even alluding to the opinions which have been formed of the origin of the human race, from the fact of the great dissimilarity in the external appearances and corporeal faculties of man in different parts of the world, we shall merely direct the attention of the traveller to the observation of all that constitutes the physical condition of the people of the country he may be examining.

It is essential to notice the general stature of the people, the form of their bodies generally, and the proportions of their limbs; the form of the skull and the facial angle; the features; have these any thing which distinguishes them from other people? Their hair,—its colour, is it smooth or woolly? Their beard; the colour and texture of their skin. Are they generally handsome or ugly? Have they much or but little muscular strength? Are they remarkable for the peculiar perfection of any of their organs, as that of sight, of hearing, of smelling; or for any corporeal faculties, as speed in running, facility of climbing, of diving and remaining long under water, or for nimbleness and dexterity, or the reverse? Can they fast longer than other people? Have certain poisons, known to be highly dangerous to others, little or no effect upon them? The same medicines and the same kind of food are known to have very different effects upon the inhabitants of different regions. What is the age of puberty of girls and boys? Is labour easy with the women or the reverse? Are the inhabitants of the country subject to any endemic or contagious

maladies, and of what kind? Are they remarkable for any particular deformity, elephantiasis, goitre, &c.? What is the ordinary length of life? Are instances of longevity common or rare? and whether life be remarkably long or short, to what may either be attributed? Are any gymnastic or other exercises practised for the purpose of preserving and increasing the physical energies?

Wherever the physical constitution of the inhabitants presents any thing remarkable, the cause should, as far as possible, be ascertained and pointed out; adding suggestions for the remedy of whatever may be injurious to health and strength.

LANGUAGE.—If the characteristic differences in the physical constitution of the different families of mankind have a tendency to inspire doubts in some minds as to the Mosaic account of the creation, the structure of languages, not less different in different parts of the world, would seem still further to confirm these doubts. Upon this part of the subject, however, we shall not touch; the fact of a great diversity of languages is positive, and the utmost result that we can hope to obtain from philological inquiries into the languages of different people, is the throwing of some new light upon the origin, the emigrations, or the inter-communications of different nations. The more immediate objects of research into various languages spoken on the face of the earth, are the knowledge and understanding of the languages themselves.

The particular observations to be made on languages may comprise generally three principal objects. *Phonology*, or the sounds, the pronunciation of the elementary articulations; *Etymology*, or the origin of words, with their successive mutations; and, *Ideology*, or the grammatical form and idiomatic structure of language.

With regard to the sounds of letters or syllables, it is often utterly impossible to express them by writing, so that unless a traveller acquire a perfect pronunciation of any particular language, he can never make that pronunciation properly known. He may nevertheless describe the general sound of a tongue as sibilant, or guttural, or nasal, or harsh, or smooth and euphonious, &c. He may even attempt to give an idea of particular sounds, by comparing them to known sounds in his own language; but this idea will generally be at best but imperfect. It may be remarked that a very great susceptibility to the delicate shades of sound is

essential to the person who would examine into, and give an account of the peculiar pronunciation of particular people.

In studying the etymology of a language, the main object is to discover the roots of words, and to eliminate therefrom the prefixes and postfixes, the explicatives, the privatives, the augmentatives, and diminutives, &c., with which they are incorporated ; the changes introduced for the sake of euphony must also be particularly attended to. The root of a word being obtained, its native or foreign origin may be in part inferred from the greater or less abundance of words in which it is found associated, and when discovered to be foreign, it lends a clue by which to guide us in the obscure history of the emigrations and inter-communication of different nations and people. Etymology also takes cognisance of onomatopeia and the similarity of words in different languages, to express the same or analogous objects and ideas. But much caution is necessary not to conclude too rashly from similarities very often purely accidental.

Ideology, as applied to philology, is that part of the science which treats of the mechanism of a language, the collocation of its words as expressive of ideas and their connexion. Children, it is observed, express themselves in monosyllables, or at least make use of those words only which express the principal or most comprehensive idea; supplying the place of connecting words and inflexions, &c., by pantomime. Analogy would induce us to believe *a priori* that the same observation would apply to whole nations. This, however, is not always the case. The Chinese, a highly-civilized people, have a language essentially monosyllabic and atactic ; the American Indians, on the contrary, have a language essentially polysyllabic and syntactic. The omission of connecting words, in the case of children, or of some savages, may arise from paucity of ideas, or of words to express them ; but it may also originate in quickness of apprehension, even where words abound, as when it is felt that time, place, and the circumstances generally, as connected with the subject of discourse, are sufficiently understood by the use of a few principal words ; the language then becomes elliptical. The saying "a word to the wise," explains our meaning. Be this, however, as it may, the structure of language is very various. In one place it is composed of monosyllables, in another, of polysyllables ; in one the modifications of a principal idea are rendered

sensible by little connecting, though separate words; in others, by prefixes and postfixes; in a third, by inflections, or systematically arranged changes in the terminations of the principal words, whether nouns or verbs. Some languages are direct in their construction, the words being collocated in the simple and natural order in which the ideas are formed; others are more or less transpositive, the natural order of the words being wholly or partially reversed. The language of some nations abounds in tropes and metaphors, and is therefore highly poetical; one idea being expressed by awakening another, in which the relations are not only analogous, but more evident; the language of other nations again is prosaic and positive. We allude to the common spoken language of a people; that of savages is often very poetical without aiming at poetry. Proverbs, or proverbial expressions, being the wisdom of ages, can only be found among an old people, and often throw considerable light upon their history and ancient manners. It is generally believed that proverbs are more common with the inhabitants of warm than of cold climates, but this we hold to be an error. It is the long existence of a people, and the multiplicity of the relations in which they stand to men and things, which give rise to proverbs. In highly civilized countries proverbial expressions are confined to the people: but to return.

The ideology or structure of languages, should be particularly noticed by travellers when competent to do so; their idiomatic expressions and grammatical system should be fully explained, and their peculiarities pointed out, or their resemblance to other languages clearly shown. Sometimes the ideology of two languages is essentially the same, though their etymology has no connexion; and sometimes the reverse of this is observable. The phonology is the most variable of all the characteristics of languages.

The object, we have said, is to endeavour to throw light upon the obscure history of mankind. When a traveller, however, has not the knowledge necessary for entering fully into philological disquisitions, he may nevertheless do something in the way of collecting materials for others; and whenever he visits a nation or tribe whose language is little known, he should make a vocabulary of as many words as possible, noting the pronunciation to the best of his ability, and observing particularly the variety of vowel sounds, and

the difference in the articulation of what may be regarded as the same consonant.

We have hitherto treated only of oral or spoken language. The generality of savage nations know no other; but ideas may be and are conveyed to the mind through the eye as well as by the ear, and this manner of conveying a language is called writing, or written language, in contradistinction to that which is simply oral.

Written language, in the large sense of the word, embraces two distinct kinds of writing; the one ideographic, and the other phonetic. In the former, material objects are represented to the eye by pictured resemblances more or less perfect, and abstract ideas by the representation of those objects which most naturally awaken them, or both by certain conventional symbols. In phonetic writing, conventional signs, not being symbols, stand either for elementary or syllabic sounds, the recollection of which is immediately brought to the mind at sight of the characters, so that the mind hears through the medium of the sight. Ultimately the sight of a word suggests at once the idea intended to be conveyed by it without any reference to its sound, or the indirect process is so rapid as to be imperceptible.

The Mexican picture-writing, the Egyptian Hieroglyphics, and our own letters, are examples of the three great classes of writing. It may however be observed, that from picture-writing to letters, there has ever been a regular gradation; as is shown in the Hieroglyphic, the Hieratic, and the Demotic, or Enchorial writings of the Egyptians; and even at the present day the three kinds of writing are sometimes used together, particularly in those writings of civilized nations where the economy of space is important.

Phonetic writing implies a high state of civilization; whereas picture-writing, whether figurative or symbolical, is in use among many savage tribes; and we strongly recommend to travellers to take correct copies of all such wherever he may find it, and to ascertain, if possible, the exact interpretation of it from the natives themselves; he should go still further, and learn whether this kind of hieroglyphic writing be arbitrary with individuals; whether each separate horde has a secret writing known only to itself; or whether there is a general and widely-extended system understood alike by hordes speaking different languages; as the Arabic ciphers are understood by all European nations. If there be a system, the traveller will do well to learn it, to copy and

explain it, adding such criticism as may lead to elucidate so interesting a subject as the process by which mankind endeavour to communicate their ideas to each other, and to preserve the remembrance of past events.

Of phonetic writing, it is almost superfluous to speak, as it is used only by the most civilized people, and the languages and manner of writing of all these are well known; thus some write from left to right, others from right to left, and some both ways alternately, some in upright columns. With some the vowels are written; by others they are entirely omitted, or their place supplied by marks placed over or under the line; some leave no spaces between the words, and others do; some punctuate the parts of sentences, and others do not, &c.

The materials on which writing is and has been executed are very various. Stones, unburnt bricks, wood, and the bark and leaves of trees, papyrus, wax, bones, and ivory, shells, prepared skins or parchment, linen, paper of various kinds, metals, &c.

From the above observations on languages both spoken and written may be easily gleaned what should fix the attention of the inquiring traveller on the subject; and if to details on the particular language of any people, he be enabled to add a satisfactory account of its origin and its general connexion with the history of the people who speak it, he will render an essential service to general science.

DRESS.—The way in which different people clothe themselves, or their dress, depends in great part on the climate they inhabit. In cold countries they use furs, woollen stuffs, &c. In hot countries, on the contrary, they either go naked altogether, or use very slight clothing. In countries subject to great change of temperature there is a winter and a summer dress.

The mode of living, exercises an influence over the forms of dress; thus the higher orders among the Turks, the Persians, and the people of the East Indies, wear wide and flowing dresses, such as are fit only for a sedentary and indolent class of people. Mountaineers, hunters, and tillers of the ground, as also certain handicraftsmen, are compelled by the very nature of their occupations to use vestments fitting to the body, and so made as not to incommode its movements.

The degree of civilization and wealth of a people determine the kind of materials used for dress; among savages

we find skins more or less prepared, or some coarse stuffs, made of the bark of trees, of grasses, &c., whilst in opulent nations we see fine cloths, muslins, silks, velvets, rich brocades interwoven with gold and silver, &c. With the former the ornaments are the gaudy feathers of birds, the tattooing of different parts of the body, collars and bracelets of fish bones, &c. With the latter the ornaments consist of gold and silver exquisitely wrought, precious stones cut and polished, pearls set with great art, &c., &c.

The laws, also, in some countries, regulate wholly or in part the costume of the people; these sumptuary laws determine the materials, the colours, and the form of the habiliments for different orders, classes, and ranks.

Among some people we find a national costume distinguishable either by the colour of the stuffs or the form of the dress, or both; the manner of wearing the beard, of cutting the hair, &c., are in many cases peculiar.

In some countries dress is above all things subject to the caprices of fashion, while in others it never changes.

Thus the observations to be made by the traveller on the costume of a people must embrace the different objects we have enumerated; he must specify the materials of which the clothing is made, its colours and forms, and the way in which it is worn: do the people go with heads uncovered, or what kind of caps, turbans, &c., do they wear; how do they wear the hair and beard; are the legs and feet uncovered, or what do they wear on them? If religious injunctions, or sumptuary laws, or custom, which has often the force of law, determine the particular dress of different classes in the social hierarchy, how are these ranks or professions distinguished? What is the difference between the winter and the summer dresses? In what do the ornaments worn by the people or by particular classes consist? Is it the men or the women only who wear ornaments, or both; what is the difference in the ornaments worn by the two sexes? Is there any difference, and what, between the dress of married and unmarried persons? What is the mourning costume of the people, and how do they dress on festive occasions, &c.? Do the men go armed; and if so, what kind of arms do they habitually carry?

The gloomy or cheerful disposition of a people, their simplicity or pride, good sense or vanity, are strongly marked in their costume.

In civilized countries, the dress of the working classes is, to a certain extent, a criterion of their more or less easy circumstances. Food and indispensible clothing are the first requisites, and it is not till these are supplied, that men think of superfluities; hence, when these latter are found among the lower classes either in the quantity or the quality of their apparel, they may be pronounced comfortably circumstanced.

We must not, however, rashly judge of the flourishing state of a people in general, from the display they make of ornament; for it is sometimes true, as a judicious observer has remarked, that "the lower orders in a country wear rings and trinkets of gold and silver only because they have not an opportunity of placing their savings advantageously." Nevertheless, this is not an axiom; one people may be more vain or less industrious than another, and may prefer an ostentatious display of their wealth to real comfort, or even to an increase of their fortune, when this is only to be secured by an increase of fatigue, and the anxiety inseparable from speculation.

Besides the details of dress itself, the observer should notice whether or not it be suitable to the country or to the habits of life of those who wear it; whether the fashions be domestic or foreign; whether the materials be of domestic fabric, or brought from other countries, and whence.

Finally, is there any thing peculiarly advantageous or defective in the costume, and if the latter, how might it be remedied?

FOOD.—Physiologists tell us, from the inspection of the teeth and stomach of man, that he is omnivorous, and experience shows this to be in reality the case; for if there be people who live entirely on vegetables, it is not from obedience to any law of nature, but in consequence of some superstitious observance, as with the Hindoos, or from want of the knowledge of the mode of procuring other kinds of food, as is the case with certain savage tribes, who find in berries and roots and other spontaneous fruits of the earth, the means of supporting a miserable existence; there are some who, according to the relations of travellers, eat a kind of earth. Even in civilized Europe there are classes of men who seldom eat meat, such as the shepherds of the Alps, the Irish peasantry, &c.; but then this is from poverty, and not

from inclination nor any physical inability in man for such nourishment, for they all eat meat when they can get it. The tribes which hunt, live on the flesh of the animals they kill, and clothe themselves with the skins: many tribes live almost entirely on fish; and herdsmen, on the meat furnished by their flocks; while those who cultivate the land, feed indifferently on flesh and on the fruits of the earth.

As it is evident, then, that man is so constituted as to feed on a great variety of aliments, it is probable that a just proportion of animal and vegetable food is more beneficial than either exclusively; though against this presumption there exist some striking exceptions. If, however, there are people whose health does not seem to suffer from the exclusive use of animal or of vegetable diet, it is nevertheless true that the temperament and physical constitution of man are greatly and directly modified by the kind of food on which he habitually lives. Thus fish diet is said to render prolific, flesh to give strength, fruit and vegetables to render men mild, but timid; strong liquors to make them quarrelsome and brutal, wine to make them cheerful, &c.; and altogether to give health, strength, and cheerfulness, provided that gluttony on the one hand, and abstemiousness on the other, be not pushed to excess.

It is with nourishment as with every thing else among civilized people; not content with mere variety of food and simple cooking, they have learnt to dress their victuals in an endless variety of ways, and to excite their palled appetites by all sorts of stimulants; thus taking into their surcharged stomachs substances whose effects are contradictory, they make themselves the willing slaves of the thousand ills which spring from intemperance, and render themselves incapable of enjoyment from a desire to enjoy too much, or from not knowing how to enjoy in moderation. This however is the case only with the opulent, the middle classes, which are the most numerous, being restrained by want of pecuniary means, are found to be more abstemious, and therefore enjoy better health, and are more robust.

We have said that in a well administered community all the parts of the great whole should harmonize, this is not the case where the rich revel in superfluities of every kind, whilst the industrious part of the nation, the tillers of the soil and the labourers, are in want of the necessaries of life.

On the subject of food, then, the traveller should observe whether it consists generally of flesh, properly so called, or fowl or fish, or milk and its various preparations, or vegetables or fruit, or several of these, or all of them indifferently. Are the provisions eaten fresh or salted, raw or cooked, and if the latter, in what way? When the food is different for different classes, the difference should be specified. Is the same kind of food eaten all the year round, or is it different according to the seasons? Is there any species of food considered impure, or which is prohibited by superstition or the ordinances of religion; if so, what are the objects so prohibited? What is the ordinary beverage of the several classes of the people, and what are their fermented liquors? Are children allowed to eat of every thing like grown-up persons, or is there any difference in this respect, and what?

Has the general food of the people, within known periods, undergone any change by the introduction of foreign usages or from other causes; what are those changes, and what effect, if any, does that seem to have had on the physical constitution or moral character of the people?

Is any thing eaten by the people observed to have any particularly deleterious effect: or do they eat any thing with impunity which is elsewhere considered unwholesome?

Snuff and tobacco, opium, beng, &c., cannot be regarded as articles of food, but as when used habitually or in excess, they are perceived to have decided effects either on the head or on the digestive organs, the abuse of these stimulants should be mentioned.

SECTION II.

HABITATIONS.

Whenever men live together in fixed habitations, there is a first degree of civilization; hunting tribes it is true, raise huts, but these are generally slight in construction and

of temporary occupancy, as they live in them only so long as the neighbourhood can furnish them with game. Pastoral tribes have more solid habitations, and they reside longer on the same spot, for the vegetable productions of the plains where they encamp afford a greater supply of food for their cattle, and consequently for themselves, than is obtained by the meagre produce of the chase. These encampments consist of tents, or wooden houses upon wheels, as is the case with some of the Tartar hordes; but still they are not fixed residences. Tribes of fishers have sometimes permanent abodes or towns; but deriving their subsistence from the waters which they possess in common, they are hardly more civilized than wandering hordes.

In general the establishment of towns can belong only to a people who cultivate the earth, at least to a certain extent. Now as soon as the land is cultivated, notions of property prevail, whence regulations, laws, and those multiplied social relations which announce incipient civilization.

We must not however be deceived by names, or imagine that a town always means what we so designate in Europe, or that it is always a collection of houses disposed in streets, such as we are in the habit of seeing, no more than when speaking of a king, we are to conclude that he inhabits a palace, and is surrounded by the pageantry of the princes of civilized states. There are towns, and even principal towns far more insignificant than the poorest of our villages, and kings much poorer than the poorest of our peasants. By the word Town then, we understand generally any assemblage of dwellings, whether above or underground, where men habitually reside, and such we say announces civilization and furnishes the measure of it. It is in the cities and towns of all countries, from the most to the least civilized, that the traveller will be able to glean the greatest sum of information regarding the civilization of those countries. In them it is that he will find the chief establishments of every kind: and, accordingly in treating of cities and towns, we will take the largest and most flourishing as a type, and will endeavour to direct the traveller's attention not only to every thing regarding the towns themselves as collections of habitations, but also to those numerous establishments which are centralized in cities.

CITIES AND TOWNS.—What is their rank as capital, government, provincial, or district town, borough, village, &c. What is the name, and the origin and etymology of the

name? It sometimes happens that towns change their names; but this change of names and the circumstances which occasioned it belong to the history of the towns.

Is the town open or enclosed, and in the first case is it desirable that it be enclosed or fortified, and why? this will of course depend upon its own importance, upon its stratagetical position or upon the dangers of attack to which it is liable. It is therefore in the chapter which treats of a country considered in a military point of view that we shall enter into details on this subject. If the town be fortified every thing regarding the fortifications should be detailed; for the manner of doing which we refer to the above-mentioned chapter on military considerations.

How is the town situated with regard to the country generally; is it in a central position or near the frontier; what is its distance from other towns, from the nearest fortresses, from sea-ports, &c.? What its longitude and latitude, its height above the level of the sea, its climate and general salubrity?

What is the particular site of the town? Is it placed on an eminence or on the side of a hill, and at what height above the plain, or in the plain itself; on the borders of the sea or of a lake; on the right or left bank of a river or on both sides? What is the greatest length and breadth in different directions, its circumference and the square surface it occupies? Note the number and the name of the principal streets, bridges, and squares or places, and their dimensions; how they are constructed and paved. Are there any side pavements for the safety and convenience of foot passengers? Are the streets lighted at night and how? What is the number of habitations and how are they constructed? The considerations regarding this last object may be divided as follows:

1. The general style of building.
2. The interior distribution of the apartments.
3. The materials of which the habitations are built.
4. The furniture.

Style of building.—There may exist in a country a general style or manner for all edifices public and private, or, as is most generally the case, there may be certain particular styles appropriated to edifices of particular destination; and, in both cases, the style may be peculiar to the country, or copied either wholly or with modifications.

In some countries the manner in which the houses are

built indicate the rank of the persons who occupy them; that is to say, this is regulated by a kind of sumptuary law, as is the case, according to Major Symes, in Ava.

When the style is peculiar to the country, it should be described. Is it derivable from the nature of the climate or the soil, or both, from the habits of the people or their particular taste?

Thus in marshy grounds or such as are subject to inundations, the houses are elevated above the level of the soil, either on piles or terraces. In countries but little subject to rain or snow the roofs are flat. In places often shaken by earthquakes, the buildings are constructed of light materials. In some countries, as in China, the buildings are fantastic in style, and ornamented in a particular manner.

In some countries where it is customary to immure the women, the houses are usually quadrangular with a court in the middle whence the apartments receive light, there being no windows towards the street or outside. The customs of certain countries require that the male and female parts of the family should be lodged separately, this, of course, has an influence on the distribution of the apartments.

When the style of building is not peculiar to the country, whence is it derived, or the buildings of what country does it most resemble? Is this resemblance an effect of chance or may it be attributed to some ascertained communication? The history of the country will help to explain this point, and sometimes the buildings of a country may tend to throw light on its origin and communications.

If the style be borrowed with modifications, what is the nature and the reason of these modifications.

Interior distribution of the houses, &c.—Are the apartments all on a ground floor, or are there stories one above another, and in general how many?

How are the apartments distributed, are there separate ones for the males and for the females? How are they warmed, by grates, or open fires, or stoves, or otherwise; in what part of the apartment is the fire placed; how are the chimneys or flues constructed, either for the circulation of heat or for carrying off smoke; what is the combustible used? How are the rooms lighted during the day, is it by apertures in the wall or by openings above; how are they lighted at night, by a great central fire or by lamps, candles, torches, or pieces of resinous wood?

Materials of the buildings, &c.—What are the materials

of which the buildings are constructed? If stone be employed, of what kind or kinds is it? and where different kinds are used, state how and where each is employed, and why. Are the stones laid in the walls in the same position they had in the quarry, or otherwise, and in either case, why; or, is no attention paid to this? What is the colour, hardness, weight, durability, &c., of the different stones employed; are they hewn and polished, or used in a rough state; are the stones cut to very large dimensions, if so, give the measurements, or are they of ordinary size, or remarkably small? If bricks be used, are they baked, or merely sun-dried; what is their colour, is it natural or artificial, and if the latter, by what process is it produced? What are the dimensions of the bricks and their form; are they compact or porous, nearly vitrified, or but slightly baked; of what kind of clay are they made? Is the clay used as it is found, or is it mixed up with sand or other material, if so, what material, and in what proportion; in a word, how are the bricks made and baked? If the buildings are of wood only, what wood is used; how is it fashioned and employed? In some countries the walls are made wholly of clay, mixed or not with stones, chopped straw, cow-dung, &c.; how is the clay prepared, and what is the process of constructing walls of it?

What cements are used in the construction of buildings in general, and of their particular parts, as for binding the materials together, for above ground work, and for the foundations, for subaqueous works, for coating outside and inside? How are the cements prepared; is the lime procured from stones, from chalk or marl, from shells, or coral, &c.?

What is the usual thickness of the walls of dwelling-houses, and how are walls in general, or particular ones, constructed? Are the outsides of the dwellings painted, and with what material and of what colour?

How are the buildings roofed, with puzzolana, or stucco, or sheet metal, as lead, tin, iron, copper or zinc, with tiles or slabs, with planks, with straw or leaves, or hides, &c?

What material is used for the windows; is it glass or mica, or horn, or oiled paper, or bladder-skin, &c.? In some countries nothing of the kind is used, there being only lattice-work, or blinds or stone slabs pierced with a variety of curious devices, &c.

Furniture, &c.—On this subject the traveller will notice

every thing which constitutes the convenience or the elegance of a dwelling, observing particularly whether the inhabitants pay most attention to splendour or to real comfort. The degree of cleanliness of the interior of the dwellings of a people generally, must be particularly noticed, and the precautions taken for ventilation and other sanitary contrivances.

Are the houses furnished with baths?

From the above questions, which relate more particularly to the towns of highly civilized countries, the intelligent traveller will easily see what should fix his attention, whenever he would describe even the most miserable *Kraal* of the Hottentots, or the Wigwams of the North American Indians.

Before we conclude the subject of the edifices of a people, we would wish to draw attention to what should be observed with regard to—

Ruins of Cities.—These will interest the traveller in proportion to his acquaintance with general history, and particularly that of the country he is visiting. When, in his perambulations he arrives at the ruins of some ancient city, it may either be the known site of a known city, or the site of an unknown city, though in a country, the history of whose ancient people is known; or it may be the site of a city unknown, and the vestige of a people equally unknown.

These different circumstances will of course call forth different kinds of observations, inasmuch, as he be disposed or able to consider these ruins archæologically; but setting aside such considerations for the present, we would point out the matter of fact observations which should always be made if a traveller has time.

What name does the place bear, and what is the meaning or etymology of the name?

What is the precise situation of the spot as regards distance and bearing from well-known places, particularly such as cannot be suspected to have undergone any change of position, since historical times? What is the particular site, and what extent of ground do the ruins cover? Can the general plan of the city or town be yet traced, as regards its exact boundary, the direction and breadth of the streets and public places, &c.? if so, these should be described, or, better still, an exact plan should, if possible, be taken. Endeavour to distinguish among the ruins, the public from

the private edifices. Describe or take plans and views of each of the former, and of one or two of such of the latter, as seem to furnish the general type. Observe the style and proportions of the columns and obelisks, and other similar objects. The character and workmanship of the several fragments of sculpture, whether figures of divinities, of men or beasts, or foliage, &c., the *basso-relievi*, and, above all, the inscriptions of every kind, which latter should invariably be copied, if possible. (See OPERATIONS.) Observe the size, form, and nature of the stones or other materials that the buildings were constructed of, and the nature of the cement which bound the materials together; observe if there are still remaining any metallic fastenings, or the vestiges of any such, and notice what particular effects time and the elements seem to have had on the several materials. A minute examination may, perhaps, show whether the ruin is the sole effect of time and neglect, or whether the city has been destroyed by human violence or by an earthquake; in the latter case, the stones will be found slipped horizontally from their places, and the rents will be such as can only be accounted for by the movement of the ground. A ponderous column, overthrown while its pedestal remains entire and vertical, if such column were isolated and formed no part of a building, can hardly be accounted for but by an earthquake or the violence of an incensed conqueror.

It were needless to add, because it must be sufficiently evident to all, that the nature of the ruins, if not totally decayed, and even then, the plans of the foundations when they can be got at, will indicate, in a most unequivocal manner, the state of the arts with the people who had built the city, and show, in a great degree, to what general civilization they had arrived.

POPULATION OF TOWNS.—The observations regarding population generally have already been given, (page 213,) but as it is generally in the capitals and large towns that the principal registers are kept, it is in such that the traveller will be the more likely to obtain the information he requires. At all events, he must endeavour to acquire precise knowledge of the progress and state of population of the capital and other towns, and compare this with the progress and state of the rural population.

What we have said regarding morals and manners, (page 220,) applies to those of the towns as well as of the country generally, but there are peculiarities in the

morals and manners of towns which should be particularly noticed.

Certain cities and towns have a special character; thus, some are mercantile, others manufacturing; some are mainly peopled with troops, others with fishermen; some are the mere resorts of pleasure, and others are of a mixed character. Hence it is evident that even in the same country the morals and manners of different cities and towns will vary considerably. It is in mixed cities and Free Ports that the greatest diversity is to be met with. In the former, the peculiarities of various classes and occupations cancel each other, leaving whatever may be strictly national in character, standing out as a prominent feature. In free ports, on the contrary, the national character is hardly to be discovered; in the heterogeneous population which is there congregated, little of what is strictly national can be discerned. Consuls, bankers, merchants, commercial agents and clerks, sailors, and travellers from all countries, present a motley assemblage, from which little else is to be gleaned than a knowledge of the extent of commercial relation. This, however, is of the greatest importance, and the details regarding it will be found under the head COMMERCE and elsewhere in the present work.

As it is chiefly in the cities and large towns of a country that the principal establishments of every kind are found, we will speak of them here.

RELIGIOUS ESTABLISHMENTS.—Under this head we comprise churches, convents, monasteries, temples, &c.; in a word, all places expressly devoted to purposes of religion, be they what they may. On such, the following observations should be made:—

What is their name, which in christian countries is generally that of some tutelary saint?

To what religion or sect are they appropriated?

Where are they situated?

When and by whom were they erected; have they ever been destroyed, and rebuilt or repaired, how, when, and by whom?

Give the details of their architectural construction and internal distribution; the number of persons they can accommodate; what remarkable pictures, statues, and other carvings, relics, trophies, monuments, &c. they contain.

The number, the rank, and the order of ecclesiastics or priests attached to them, or of monks, nuns, dervishes, &c.

What is the general character of the monastic establishments as regards morals, and the influence they exercise on the community generally?

What are the treasures of the religious houses and establishments, and the landed property they possess?

How, and at whose expense are they maintained? What is their general history, &c.?

ESTABLISHMENTS OF INSTRUCTION.—Such as Institutes, Colleges, Academies, Gymnasiums, Public and Private Schools of all kinds, and for both sexes; of these observe:—

Their names, where situated, their architectural details, by whom founded and supported.

The sciences, the languages, or the arts which are taught in them; the number of students or scholars.

Has their number increased or diminished since the first foundation, and what has caused these variations?

What are the principal regulations of the several establishments, that is to say, at what age do the students enter, at what age do they leave, what knowledge is required of them on entering, what is the mode of instruction, what attention is paid to the morals of the pupils? Are gymnastic exercises taught, and what is the food of the boarders? What are the rewards and punishments; how are the examinations conducted, what are the vacations? Do the professors and students wear any particular dress, and what? Is attendance at these establishments public and obligatory, and consequently general, or are any class exempted; and, if so, who are the privileged? Are the establishments of instruction paid by the state or by private contribution, or in part by both? What becomes of the students and pupils when they leave the schools, what is the number, the rank, and the salaries of the masters and professors; what are the qualifications required of instructors, and what means are taken to secure such qualifications? Is the remuneration of the masters and the general consideration in which they are held such, that persons of merit and high standing in the learned world can devote themselves to tuition without prejudice to their reputation, or is the contrary the case; and, if so, what is the effect of such a state of things upon public education?

What is the number and distribution of the public schools in the towns and in the country?

What support do they receive in general from the government?

Is the mode of instruction the same for all the establishments of the same kind throughout the country?

Is the method in all things conformable to the end proposed?

Does the nation possess all the different kinds of educational establishments which are required by its climate, its civil and political state and general civilization, or are any wanting, and what are they? Is it lawful for any person of ability and good moral character to establish private schools; is the kind of instruction given in these conformable to that of the public schools, or is it arbitrary? Are private schools subject to visits of inspection?

What is the number of students or pupils of both sexes, separately and together, educating in the public and private schools of a general nature, and what the number of those educating for particular professions and callings?

What sum of money from the public fund is appropriated to the purposes of education generally, &c.?

ESTABLISHMENTS FOR CHARITABLE PURPOSES.—These comprise hospitals, houses for the reception of new-born infants, depôts whence medicines are gratuitously distributed, &c., &c. They are both public and private, that is to say, supported by the nation at large, and by private contributions.

What is the total number of either kind; and for each in particular; what is its name, where situated, what is its architecture, and more particularly its internal distribution and arrangements as regards its particular object?

What is its destination; is it as a retreat for old or disabled seamen or soldiers, or for the old and disabled generally of either or of both sexes; was it founded for giving work and food to the poor, or for curing the sick and wounded, and for affording assistance to, and recovering the strangled, the smothered, the drowned, the burnt, the frozen, &c.; for the care and cure of lunatics; for the delivery of poor women; for the reception and education of disowned children; or for the gratuitous delivery of advice and of medicines, and for vaccination? Is it maintained at the public expense or by private contributions, or both; in the latter case, what portion of the expense is borne by the government, and what by private individuals; if it be wholly

supported by voluntary contributions, is the sum paid optional or determined? What are the particular regulations of each establishment, and how is it administered? Is the mode of administration beneficial or the reverse?

In all hospitals for the cure of the sick, the proportion actually cured should be stated, as also the number that die in the infirmaries. The number of inmates of every charitable institution must also be mentioned, and the number of out-patients or persons to whom relief is afforded.

In most civilized countries there are retreats for respectable persons of broken fortunes; such establishments being founded and supported by individual charity and bequests, or by corporations, for the benefit of those only who are of their own profession.

To what sums may the maintenance of the charitable institutions of the country, the public and private ones separately, and the whole together, amount annually?

Schools for the gratuitous education of the children of the poor are undoubtedly charitable institutions, but they belong more properly to the article *Public Instruction.*

There is another kind of charity which perhaps more particularly belongs to the article of *Police.* We allude to penitentiaries, where such females of loose habits, are received as have taken a resolution to abandon their miserable course of life. In these houses they are cured if sick, their talents are turned to account, and after a certain probationary time, they are placed out in a manner advantageous to themselves and the public. The prevention of immorality is as much an affair of police regulation as of charity; but such houses are usually classed with charitable institutions.

ESTABLISHMENTS FOR THE ADMINISTRATION OF JUSTICE.—This article comprises all those places where justice is administered either according to law, or equity, to customs, or usages.

What is the number of these, their names, situations, organization, &c.; the rank and authority of the judges, or other persons who preside at them; the terms of sitting, &c.? The legislative system in general requires considerations which are mentioned elsewhere. See LEGISLATION.

POLICE ESTABLISHMENTS.—These are town halls, the tribunals of correctional police, the prisons, the repositories of engines against fire; in a word, every thing appertaining to the police of the city properly so called; but

these are of minor importance as compared with the regulations of the police itself. Police is of two kinds ; the one has reference to municipal rules and regulations for the maintenance of order in towns ; it prevents disturbances or breaches of the peace, takes cognizance of petty misdemeanors, looks to the cleanliness of the town, and the general security, comfort, and convenience of its inhabitants. The other kind of police is the high or secret police, an establishment happily unknown in England and in the United States of America, but almost universal elsewhere. This kind of police is not more odious in principle than demoralizing in its effects ; it is the resource of tyrants and despotic governments, and is destructive of that fearless confidence without which the people can never be truly great.

Both kinds of police have their respective officers ; but as too much publicity cannot be given regarding those of the former, in order that all may know who they are, the extent of their authority, and where to apply to them,—the officers of the secret police, on the contrary, are altogether unknown, except the head of the establishment, who is generally a high personage, and one of the principal ministers of the state.

As to the municipal police, the traveller should note how many police stations there are in the city ; if they are sufficiently distributed and numerous ; how the whole body of the police is organized, and what are the respective powers and authority of the different persons who compose it ; the total number of persons forming the establishment ; the expense of keeping it up, and by whom that expense is defrayed. Are the several persons engaged in the police sufficiently well remunerated to place them above the temptation of receiving bribes ? Are the inferior ranks well-conducted, steady, sober, and zealous in the performance of their duty, or the reverse ? What are the particular duties of the different departments of the police ?

How is the city guarded by night and by day ? What are the police regulations regarding persons found dead, regarding burials, regarding slaughter-houses, and the supply of the markets, and the quality of the food sold there ? How are false weights and measures detected and punished ? What is the law regarding the selling of poisons and deleterious drugs by apothecaries or others ? What are the preventives against mad dogs ; against foot passengers being injured by those on horseback, or by vehicles, or against

accidents to the latter ; against fire and the means of saving people from the flames ? Are the pavements kept in order, and the streets well lighted ? Are all impurities immediately carried away and the town kept clean ? How is it supplied with water, is this of a good and wholesome kind, and in sufficient abundance ? What regulations are there regarding drunkards and disorderly persons, abusive language, indecent behaviour, cruelty to animals, &c. ? How are the theatres and other places of public amusement regulated ; as also coffee houses, furnished lodgings, public houses, public coaches, &c. ?

Are sacrilegious, scandalous, and other improper publications, whether in print, manuscript, or drawing, punishable by the police ? What are the regulations respecting the observance of holydays and religious ceremonies ? Is gambling punishable, and how is it prevented or detected ? Are public assemblies of the people tolerated if they commit no open acts of violence ? May the inhabitants go armed if they please, or is the carrying of arms prohibited ?

What regulations are in force regarding the arrival, sojourn, and departure of foreigners, their passports, &c. ?

What are the punishments of correctional police ? What are the prisons, and how are they regulated ? These should be minutely examined by the traveller, who should particularly observe whether or not proper attention be paid in them to the health and moral improvements of the inmates, or the reverse.

In most civilized countries the police regulations may be obtained, and should therefore be procured. The observations of the traveller will then be directed to their efficacy, for it sometimes happens that excellent regulations are useless from not being properly carried into effect.

MILITARY ESTABLISHMENTS.—Under this title are comprised barracks, guard-houses, military hospitals, exercising houses, arsenals, store-houses, magazines, &c., each of which objects require particular considerations.

What is their number, and how are they distributed in the city ? What is the extent of the barracks, how are they constructed, and where are they situated ; what is their internal arrangement, how many men and horses can they lodge ? Where are the several guard-houses situated, and what number of men usually mount guard at them ?

As for military hospitals and schools, they require the same kind of observations to be made upon them as those

already pointed out for schools and hospitals in general. Where are the esplanades and exercising grounds situated, and their extent; as also the number of men that may be manœuvred on them? What is the number of the garrison and its composition? Are the arsenals spacious, convenient, and well secured? What quantity of cannon, powder, muskets, or other arms and ammunition do they contain?

COMMERCIAL ESTABLISHMENTS. — Specify the private and public banks, the commercial houses, the mint, the custom house, the exchange, the insurance offices, the warehouses, the docks for the construction of merchant vessels, the commercial schools, &c. Examine all these in detail, as to the particular nature and organization of each.

As for banking systems in general, we shall speak more fully of them in the chapter on COMMERCE; here the details of each kind of bank in particular must be observed. With regard to public banks;—on what principle are they established, what funds have they, what is the amount of notes in circulation, and of bullion in the cellars? Have foreigners deposits in the bank, and to what amount? What variations have taken place in this respect within a given period, and what have been the causes of these variations? What are the principal operations of the several banks, and the confidence placed in them? What is their origin, and what remarkable facts regarding them does the financial history of the country present? How are their labours regulated and distributed? With what country do they transact the greatest amount of business? As for private banks, ascertain the name and place of abode of the principal bankers; the most probable valuation of the capital possessed by each; the places with which they chiefly correspond, &c. Are bankruptcies rare or of frequent occurrence among them, and in either case, what is the reason?

What influence do the bankers and their system exercise on the value of land; on the industry or the commercial prosperity of the country, on the circulation of money, &c.?

Is there a chamber of commerce or board of trade? what are its functions and its influence; of whom is it composed, and how is it organised?

Is there a mint; if so, inquire into the establishment, its labours, and their organization. What quantity of money of each particular kind is struck annually; what have been the variations in this respect for a certain number of years? does the mint coin for other countries; if so, for which, and

to what amount, and what do they gain for this? What are the machines in use; what are the principle assaying processes? Whence are the metals procured; do they come in bars or ingots, in specie, or in dust, &c.

Examine the custom house, the excise offices, and other establishments for the receipt of taxes; where are they situated, how are they distributed and organized; what is the number and rank of the persons employed in them, and for the collection of the revenue in general? How are the registers kept? Is the mode of transacting business expeditious and easily understood? What are the general results of the system, both as regards the treasury and the public?

The Exchange,—where is it situated; what is its construction; at what hours do the merchants and others assemble; what are the affairs transacted there? What are the principal warehouses and storehouses, and where are they situated; are they well secured against fire and robbery; what kinds of stores are they particularly intended for, or do they contain; what are the regulations and privileges of the city regarding them?

If the town under consideration be a Port, what yards and docks are there destined for the construction of merchant vessels, and for the unloading and shipment of cargoes; what quantity of vessels are annually constructed; what number of vessels arrive annually, and what is their united tonnage?

On the subject of commercial schools, see SCHOOLS in general. What are the names and residences of the principal merchants, and the objects of their commerce?

There is a very great variety of establishments connected with commerce, and which are of course so much the more numerous as the city and people generally are more commercial. It is impossible to detail them all, but sufficient has been said to serve as a hint for the inquisitive traveller, that he should observe as closely as possible every thing regarding the commercial establishments of the city in which he may be residing, and glean all the information he can respecting them. Further observations on commerce generally will be found under the head of the COMMERCIAL INSTITUTIONS OF THE COUNTRY.

ESTABLISHMENTS OF INDUSTRY.—Under this head we include the manufactories and large workshops, established in the city.

What number is there of each kind; what number of persons is employed in each, and what is the total number of artisans? Is there any thing remarkable, and what, either in the construction or distribution of the factories or workshops, and in the different processes carried on in them? Are any particular localities or parts of the city, appropriated or occupied by manufactories of any particular kind, &c.?

SCIENTIFIC ESTABLISHMENTS.—*Botanic Gardens*,—where situated, of what extent; what are the rarities they contain; what degree of care and attention is paid to these gardens; are any experiments made in them for the naturalization of useful or ornamental plants, shrubs, and trees; what are these, and what success has been obtained? Are seeds and shoots liberally distributed to those who apply for them? At whose expense are the Botanic Gardens maintained, and what sums do they cost annually? Are they open to the public?

Amphitheatres of Anatomy,—where situated; how are they constructed; what are the names, and what is the merit of the professors; what courses do they give, and at what times; are they gratuitous or paid for, and by whom; what number of students frequent them? How are subjects of dissection obtained?

Observatories,—where situated; are they well or ill supplied with instruments; where are these made, are any of them remarkable for size or beauty or accuracy of workmanship; what meteorological and other registers are kept; what remarkable discoveries have signalized the observatories, when, and by whom made; how many persons are employed in them, and under whose direction are they immediately placed?

As for *Cabinets* and *Museums* of all kinds, public and private, what are they, their names, number, and situation; the order that reigns in them; their particular riches; and are they much frequented or not? Are they gratuitously open to the public or otherwise, at all times, or only at particular seasons; and if so, what are the days and hours that they may be visited?

Libraries, Public and Private.—Their numbers, name, and situation; the number of volumes contained in each, and the kind of books, the manuscripts, &c. which they contain; by whom and when founded; at whose and at what expense maintained; under whose superintendence

are they placed; what are their regulations; have the public constant, easy, and gratuitous access to them; what are the most valuable objects to be found in them, &c.?

Are there any numismatical collections, how many, and where, what does each of them contain?

Are there any gratuitous courses of lectures; what are they; when, where, and by whom given, and on what subjects particularly; are they much frequented; what kind is most to the taste of the inhabitants?

What are the several Literary and Scientific Societies, and the particular objects of each; how are they supported; are they well furnished with books, instruments, drawings, &c.? What is their influence for the general propagation of science? What are the several periodical works, journals, gazettes, &c., and the influence they exercise respectively? Is the press entirely free, or is it subject to a censorship; is this latter rather nominal than real, or is it strictly and severely exercised; and if so, what is the extent of its baleful influence on the character and conduct of the nation?

POST ESTABLISHMENT.—What establishments are there for the conveyance of letters; where are the central and branch establishments situated; what is the number of persons employed in each, and the total; what are the hours of departure and arrival for different directions; what are the principal regulations regarding letters and packets, the sending of money, couriers, &c.? Sometimes the posting establishments for travellers are united with the letter posts, and sometimes they are separate. In some countries posting is under the immediate superintendence and control of the government, in other countries, post-houses are kept by private though licensed individuals.

In all cases the letter-post offices, and the post-horse, mail, and stage-coach establishments should be noted. What number of coaches and of what kind start daily, or otherwise, from the particular places, for different directions; what are their hours of departure and arrival, the charge for places; the quantity of luggage allowed; the general regulations and usages regarding these objects, &c., &c.?

SUPPLIES OF THE CITY.—What flour mills are there in the city or its vicinity, and of what kind; what is the number and situation of the slaughter-houses, flesh markets, and the markets for live cattle, fish, poultry, butter, and eggs, vegetables, fruit, flowers, grain, forage, &c.? Whence do

the several articles of provision come, &c.? What fairs are there, when held, for what objects, and how frequented?

What do these several objects present particularly worthy of notice? How is the city supplied with water, and of what quality is it, is this necessary article never scarce, or if water be wanting, what is the reason, and what might be done to prevent so great an evil as a scarcity of water?

What is the usual consumption of the several kinds of provision, and their estimated value; are there any taxes or fiscal regulations which tend to lessen the necessary supply of any article of consumption, &c.?

AMUSEMENTS.—State the number and the names of the theatres, operas, concert-rooms, circuses, &c., and the nature of the performances in each; what promenades, gardens, assembly-rooms, or other places of public recreation, there are; what exhibitions of products of arts, &c., with the name and the nature of each; where they are situated, how attended, and what influence they have on the public manners and morals, or how far they serve to indicate the disposition of the people.

SOVEREIGN'S COURT.—The Palaces and residences of the Sovereign in detail, with all they exhibit or contain worthy of particular observation, should be noted. What is the etiquette of the court, the household establishment of the sovereign; what are the members of his family, and their several establishments, &c.?

CENTRAL OR GENERAL GOVERNMENT.—As the offices and various establishments of the General Government of a country are usually in the Capitals, it is there that the traveller will make his observations on the Councils, the Senates, the Parliaments, the Legislative Assemblies, &c. What are their places and times of assembly; their respective powers; the names and rank of the persons who preside, &c.? Under the heads of GOVERNMENT, LEGISLATION, &c., further observations on these subjects will be found.

PARTICULAR GOVERNMENT OF THE CITY.—How is the government of the city or town organized, and what are the limits of the power and prerogatives of the several magistrates and of the citizens?

AMBASSADORS.—What foreign Ambassadors, Envoys, and Ministers usually reside in the city; what degree of respect is shown to them generally, or to any in particular? Are they lodged at the expense of the city or of the

government, or at the expense of their respective courts? Where do they severally reside; what is the rank of precedence among them, and which makes the greatest display, &c.?

PRIVILEGES OF THE CITY.—What are the privileges of the city or town, the expenses it is charged with, its revenue, its domains, its debts, &c.?

HISTORY OF THE CITY.—What is the history of the city from its first formation, the famines, plagues, pillages, devastations, revolutions, riots, &c., to which it has been subject? What are the principal causes of its prosperity or decline; its increase of extent at different periods, &c.?

What are the best maps, plans, descriptions, &c., of the city, and where may they be had?

How are the environs of the city, and what do they offer that is of particular interest?

In thus drawing the attention of the traveller to many of the objects most worthy of his notice in cities and large towns, we have unavoidably mentioned many things which relate more to the country at large than to the city itself; but as it is in cities, as we have said, that the principal establishments of a country are found, we thought it would be well to mention them in this place; on the other hand, an immense variety of objects will be found wanting in our questions; we hope, however, we have omitted nothing really essential. Besides, to enter into every particular, would require many volumes, and we must always leave much to the traveller's sagacity, to awaken which, is our sole object, leaving him to fill up our blanks to the best of his own judgment.

DIVISION IV.

INDUSTRY.

SECTION I.

AGRICULTURAL INDUSTRY.

INDUSTRY IN GENERAL.—Industry in general is divided into three principal branches; viz., *Agricultural* industry, *Manufacturing* industry, and *Commercial* industry: these are, however, so intimately connected that the one cannot exist without the others, and the prosperity of either is sure to have a beneficial influence on the rest.

There is yet another kind of industry which, properly speaking, belongs to neither of the former, but is equally necessary to them all—the industry or labour of the mind, comprising the writings of authors in general, whatever be the subjects they write upon: the labour of organization and direction of various establishments, &c. Of this kind of industry we shall speak presently.

AGRICULTURAL INDUSTRY IN PARTICULAR.—The three great branches of industry, we have said, are intimately connected, so that it is impossible to analyze the one without meeting with several objects which belong to the rest; and this renders a strict classification extremely difficult, if not impossible. Under the present head of *Agricultural Industry*, however, we will speak of the different occupations which have for their object, to obtain from the land and water the necessaries of life, and those raw materials of different kinds which are afterwards to be worked up by the *Manufacturing Industry*. Under this same head of agricultural labours, we also include all those

preparatory manipulations which are executed by the country people to render certain objects marketable, as well as everything relating to cattle, to agricultural implements, buildings, &c. We shall, therefore, divide agricultural industry as follows :—

1. Those labours or occupations whose object is the collection of the spontaneous products of the land and water, animal, vegetable, and mineral.

2. The labours whose objects are to preserve, to increase, and to bring to perfection the fruits of the earth, the useful animals and their produce; which labours will also be subdivided according as they refer to animals, vegetables, or minerals.

3. Agricultural implements and buildings.

COLLECTION OF SPONTANEOUS PRODUCTION. —This includes hunting, fishing, the collection of wild honey, and of insects used in dying, in medicine, for the cabinets of the curious, &c.

Hunting.—Beasts and birds are hunted for different purposes; sometimes it is in order to rid a country, province, or neighbourhood of noxious animals; sometimes it is for food; and sometimes for their hides, feathers, &c. In America, whole herds of cattle, to the number of 30,000 or 40,000, are hunted and killed for their skins. The Chamois, in Europe, is also hunted for its skin. Sometimes animals are hunted in order to obtain specimens for cabinets, and sometimes with no other object in view than what many consider an amusement. The hunting of noxious animals is either with a view to diminish their numbers, or wholly extirpate them; and for this purpose governments occasionally offer considerable rewards. It was by such means that wolves were destroyed in England, and in the neighbourhood of Calcutta a premium is given for every tiger killed.

But carnivorous animals are not the only ones that are noxious; rats, moles, &c., sometimes cause considerable damage; in like manner there are destructive birds which it is desirous to get rid of, such are sparrows, among others. The mischief occasioned by these little birds is inconceivable; every one of them eats, upon an average, from ten to twenty pounds weight of grain annually, and their number in certain districts is immense. In Brandenburg and in Baden Durlach, a price used to be, and, for all we know, is still, set upon their heads.

The hunting of animals, as an object of food, is almost the sole occupation of the male population of many savage nations, known accordingly as hunting tribes. These, however, do not always hunt merely for food. The great value of the furs of many animals, and their extensive use in clothing, has rendered them a most important article of traffic, and, accordingly, the animals whose skins are in most repute are hunted for their furs. The quantity killed for this purpose, in America and in Asia, is immense.

In civilized countries beasts and birds are hunted generally for amusement, or to procure delicate viands for our tables. Some few animals are taken for their skins, which are all, more or less, a valuable, and therefore a marketable commodity.

The taking of animals for our menageries and museums hardly forms a distinct occupation, though some few individuals, in the Brazils and in the East, get a living by taking and selling animals, or beautiful birds and insects, &c. As we are not, however, speaking of the animals themselves, but of that branch of rural industry which is confined to hunting, we would point out, as worthy of the traveller's observation, the following objects:—

The number of persons occupied solely in hunting. In this number will be comprised hunters of every description, gamekeepers, &c.

In this number, are there any regularly paid and maintained for the exclusive purpose of destroying noxious animals, and are they all paid by the state or by individuals?

At Baden Durlach the sparrow-killers are numerous; they sell the dead birds to the peasants, who are obliged to produce a certain number of them, and who have not time to devote to their destruction.

What is the annual expense incurred for this necessary extirpation of noxious animals? Is any profit derived from their furs or feathers, and to what amount?

What may be the number, and what are the kinds, of noxious animals annually destroyed?

In countries where the right of killing game does not belong exclusively to any privileged class, there are generally a number of persons who, in the hunting season, devote themselves to procuring game for sale; what may be the number of such persons, and the annual produce in number and value of this their labour? This class of men in some parts of Russia is very numerous, and the loads of game

annually brought to St. Petersburg and Moscow are truly astonishing.

Nevertheless, as in most cases it is the peasants who, in their leisure hours, kill a few heads of game, and as the consumption in thickly peopled countries is very limited, this species of hunting is not important. The skins, however, of wolves, of foxes, of hares, of badgers, &c., have a certain value, and are often kept by the country people till a sufficient quantity be collected to take to market, where they are bought up by furriers, tanners, hatters, &c. The quantity sold by each individual is generally insignificant; but the total number of skins of wild animals thus used, even in populous countries, is very considerable, and should, if possible, be ascertained.

In some countries the rigour of the climate is such, that furs are an article of indispensable necessity. In such countries hunting is always an object of importance, but, of course, greater or less according to the demand for furs and the facility or difficulty of procuring them. Some countries produce furs enough to form an extensive branch of export trade; others are obliged to buy them.

In a word, hunting may or may not be of sufficient importance in a country to fix attention in a statistical point of view; when it is, the main object should be to ascertain the kinds, the quantity, and the value of the several products obtained, whether raw hides, precious furs, castoreum, feathers, &c., and the number of persons employed in the several occupations of hunting. What is the capital engaged in this kind of industry?

Should hunting, however, not be sufficiently important to fix attention as to its products and the number of persons employed, it may, nevertheless, be extremely interesting as to its various operations, whether they be grand hunting expeditions or lesser hunts, with dogs, falcons, or weapons, or whether the animals be taken in snares or otherwise. Hunting is also worthy of attention in connexion with the manners, the character, and the physical constitution of the people.

Fishing is carried on, more or less, in every country, savage or civilized: there are even whole nations who feed exclusively on fish, and who are, therefore, styled *Ichtyophagi.* In some places fisheries are free, in others they are a monopoly, enjoyed either by the government, by companies, or by certain individuals.

Individual fishing, like individual hunting, that is to say, such fishing as is practised by a few indigent persons for their own subsistence, or for the occasional sale of its slender produce, is not worthy of fixing our attention, in any way; but the great fisheries of lakes, of rivers, and of the sea, are often an object of the highest importance as well from the value of their produce, as for the number of persons employed, and the large capital sometimes engaged in such enterprises.

The Roman and Greek Catholics, by reason of their fasts, and also the Jews, consume an immense quantity of fish. Thus in Poland, where the whole of the population is composed of Catholics and Jews, the quantity of fish consumed is very great, though much less than it would be but for two causes, the extreme poverty of the peasants and of the Jews, and the mediterranean position of the country, it being at a distance from the sea. This latter circumstance is the reason why by far the greater quantity of the fish consumed is obtained from the small lakes and the rivers of the country.

The sea fisheries along the coasts of all civilized countries give employment to a very great number of persons; sometimes they are carried on by independent fishermen, and sometimes by companies, and these latter extend their operations to distant seas, and fish for whales, for cod, for herrings, &c. Fisheries are undertaken either for obtaining the fish as food, or for some particular produce which they furnish, as whale oil, seal skins, &c. Be the objects, however, what they may, the details regarding the fisheries should be noted by the traveller, who would do well to make the following observations:—

What is the kind, the quantity, and the value of the produce; the number of persons engaged in fishing, exclusively of those employed in the construction of the fishing vessels and boats, their rigging, &c.; for these builders do not in general confine their labours to working for the fisheries, and enter into the class of artisans. The persons employed in salting and packing herrings must not be included either, for their occupation is not simply the collecting of raw produce, but the preparation of it. Eventually, every thing not mentioned here, but which may be pointed out in other parts of this work, as having a direct relation to the fisheries, may be collected by the traveller under one head, but the operation is not easy; it is difficult to ascertain the precise amount of capital employed in the fisheries themselves

exclusive of such accessories, as the construction of vessels, boats, gear, &c.

In that class of industry of which we are now treating, we include the coral, sponge, and pearl fisheries; the kind, the qualities, and the value of these objects must, therefore, be noted, together with every remarkable detail regarding the several operations.

Collecting of Wild Honey, and other Spontaneous Animal Productions.—In several countries wild bees are so abundant as to render the collecting of their honey an object of some importance; thus, in Russia, in Poland, and we believe in East Prussia, a custom prevails of improving somewhat the natural hollows of the old pine trees of the forest, and closing them up with a board so as to form a rude kind of hive in which the swarms settle, and which they store with their honey. This is collected by the peasants, who in the forests belonging to the crown, at least in certain provinces, pay an annual impost for each hive prepared as above stated. As this object, however, occupies no body exclusively, there is no estimate to be made of the number of individuals employed in this operation; but the traveller should, if possible, ascertain the quantity of wild honey collected, and of the unprepared wax thus obtained.

There are other kinds of spontaneous produce more or less important. Such are the eider-down, the edible bird's-nests of Java and other islands of the Indian seas. Yellow amber, ambergris, *Guano*, or wild fowl's dung, &c. As for the eider-down, it is known to every one to be the produce of an aquatic fowl of the North. Ambergris is that precious substance found floating in certain parts of the Indian Ocean, and the origin of which is as yet but imperfectly known, but which is always a scarce production and much esteemed as a perfume. The swallows' nests of the East are a much more important object than is generally believed. The Chinese are exceedingly fond of them, and according to Sir Stamford Raffles, those collected in the Island of Java produced an annual revenue of about 40,000*l.*, the expense of collecting being a mere trifle. The *Guano*, or cormorant's and pelican's dung, collected on the rocks of the western coast of South America is worth upwards of 37,000*l.* per annum. Pigeon's dung was formerly an object of great importance in Persia; each pigeon tower, and the number was prodigious, produced dung of the value of 100*l.* per annum; so that, if we estimate, from their present vestiges,

the number of pigeon towers to have been only 500, the dung alone was worth 50,000*l.* per annum. It was used in the preparation of saltpetre, but the little that is now collected is employed as manure, chiefly for the melon beds ; it being said to communicate to the fruit a flavour highly esteemed.

These facts are stated here merely to apprise the traveller, that very often objects which he may think too trifling to notice are in reality worthy of his particular attention.

Since bones have become a valuable manure, and are employed in different processes of the arts, many persons do nothing else but collect those which lie scattered over the fields in certain countries. Whole ship loads are thus collected, and form an article of exportation. We are not, however, to presume from this that all the bones sold are so collected.

The collecting of insects for dying, for medicinal purposes, for naturalists, &c., also deserves the attention of the curious traveller, who should notice what are the objects collected, and their value.

Collecting of Spontaneous Vegetable Productions.—This is an object of small importance in highly civilized countries, but in other places is often deserving of attention ; thus in some parts of Russia vast quantities of hazel nuts are gathered and sent in inconceivable quantities to the capitals and other towns ; wild berries also, in this country and in Finland, are an object of some value ; ship loads of cranberries are brought from the latter place. The collection of sea weed, in different places, and that of the dying lichens from off the rocks of the Azores and in the Adriatic, occupy a number of people, and the produce is of considerable value.

Besides these objects there are other spontaneous vegetable productions, as shrubs, roots, herbs, berries, &c., collected chiefly for the apothecaries, dyers, &c., and some of these vegetable drugs are used in such quantities, and employ so many persons in the collecting of them, that they are very important.

The spontaneous crops of meadow grass is an object of great value, but the cutting of it is never an exclusive occupation, so that on this subject little is to be learnt but the mean annual value of the produce.

In short, whenever any spontaneous vegetable production is of sufficient value,* or is employed in sufficient quantity

* Mahogany, logwood, &c. come under the head of spontaneous

to render the collecting of it so important as to occupy many persons, at least at certain times of the year, the nature of such productions, the quantity, the uses to which they are applied, their value, the modes of collecting, the number of persons employed, &c., are all objects worthy of attention.

Collecting of Mineral Productions.—Every substance in the mineral kingdom is a spontaneous production of nature; man cannot increase metals and minerals as he can cultivate the vegetable productions of the earth; and if we class, with Storch and other writers, the labour of collecting minerals with rural industry, it is only because it is an occupation which belongs rather to the inhabitants of the country than to manufacturing or commercial industry, and because the classification as such is of little consequence. Nevertheless the great importance of the minerals of a country and the particular nature of the labour of collection entitle them to particular consideration; and it is for this reason that we have given a notice of the observations to be made on this subject under the head *Mineralogy of a Country* (which see).

We shall now remark that with regard to the kind of industry of which we have been speaking, viz., that which is occupied in collecting the spontaneous productions of the earth, it would be well if the traveller could fill up the details in a table.

AGRICULTURAL INDUSTRY, properly so called; or, LABOURS WHOSE OBJECT IS TO PRESERVE, TO INCREASE AND TO IMPROVE THE FRUITS OF THE EARTH, USEFUL ANIMALS AND THEIR PRODUCE.

Animal Kingdom.—The rearing and keeping of domestic animals and of poultry, of fish in ponds and reservoirs, of bees, &c., furnish occupation to a great number of persons, and are objects of considerable importance, and every thing regarding them is worthy of particular notice. Of course the most useful animals will claim the traveller's chief attention, such as horses, mules, asses, oxen and cows, buffaloes, elephants, camels and dromedaries, rein deer, lamas, sheep, goats, dogs, &c.

Note should be taken of all the domestic animals of the country, with every thing which particularly characterizes

vegetable production, but their importance is such, together with their limited locality, as to require being treated by themselves when mentioned at all by the traveller.

them, and the useful purposes to which they are applied, the manner in which they are reared and kept, that is to say, their food at different seasons, its preparation, and the quantity given; the kind of shelter under which they are secured, the diseases they are subject to, and the way these are treated; the measures adopted for multiplying the breeds and bringing up the young; the modes of improving the breed, either with a view to increase of strength, agility, beauty, &c., as when the breeds of horses are crossed; or for bettering the quality of some of their products, as when breeds of sheep are crossed to improve the quality of the wool, &c., or for increasing the flavour of the flesh of such as are eaten, as in the case of horned cattle being sent to graze on particular pastures, &c.

The care and attention paid to the rearing and keeping of all kinds of poultry, and of each kind in particular, should be attentively observed, and the same thing may be said of fish in ponds and reservoirs; of game in preserves, &c.

The rearing of silk-worms, together with the care and preservation of the plantations of mulberry trees, belonging to rural industry, though a distinct branch of it, must be here noticed. The subsequent various preparations of the silk itself belong, of course, to manufacturing industry.

The care of bees is seldom an exclusive occupation, and although the honey, and particularly the wax obtained are important objects, we are here to consider merely the care bestowed on the bees themselves.

Besides these several objects of consideration, the following should be noted.

What quantity of each kind of useful animal, whether beast, bird, fish, or insect, is produced in the country; what is the expense and the profits of rearing; where is the best quality of each kind found, and what are the principal markets for the sale of these animals or their produce. Are any, and which, exported or imported, where to, and whence, and to what amount annually; is the exportation or importation favoured or discouraged; is any encouragement, and of what kind, offered by government or others for improving the breeds of cattle and other animals, or their produce? What number of persons may the several occupations of breeding, rearing, and tending the useful animals of the country amount to, and what is the amount of capital engaged in this kind of industry, &c.?

Vegetable Kingdom.—The labours we have now to con-

sider are those which have for their object the preservation and increase of useful vegetable productions, and the amelioration of the several species; the tilling and improvement of land; the increase in the quantity and quality of the useful grains; the formation of artificial meadows; the preservation of forests and cutting of the timber; the plantation and care of quickset hedges; the care of vineyards, orchards, and fruit trees of all kinds, and of kitchen gardens; plantations of the tea plant, the sugar cane, coffee trees, cacao, or chocolate-nut trees, mulberry trees, spice bearing plants, oleagenous plants, gum bearing trees, &c. The consideration of all these objects in detail, and of every thing connected with them, constitutes the greatest and most important part of the observations to be made on agricultural labour, and therefore requires the most particular attention.

The staple article of food for man, in civilized countries, is derived from the *gramineæ;* and we have cattle only in as much as we have wherewithal to feed them. Thus, the cultivation of the earth is the chief and most important labour of man; for, strictly speaking, we can do without manufactures and commerce, but not without food.

We do not mean from hence to infer, that man should confine himself to supply the primitive wants of his nature, or limit his labours and his researches to what is strictly necessary for the support of existence; such a state would keep him at too low a level in the creation, and be reprehensible from the non-employment of his noble faculties. His superior understanding was given him that he might augment the mass of his enjoyments. No sooner was he united in that social state for which he was evidently destined, than multiplied relations sprung up which, developing his intellectual faculties, were the prelude to those astonishing discoveries, those bold enterprizes, that have given to him the mastery of the world. The laws of nature have been made subservient to man, and her various productions minister to his wants, his convenience, and his luxury. But the chief of these productions, those indeed without which none others can be obtained, are the immediate produce of the soil; and arts, manufactures, and commerce, flourish only in as much as agriculture is improved.

In well administered countries, those we mean, in which, if we may use a figure, industry is permitted to administer her own affairs,—where despotic and ill contrived

systems neither impede nor paralyze her efforts, she is ever found in as prosperous a state as other circumstances permit.

In regular order, we should next allude to those labours which are applied to the elaboration of the *mineral kingdom*, but the details regarding this department have been already mentioned under the article METALLURGY; we shall therefore proceed at once to treat of agricultural affairs.

DISTRIBUTION OF LAND, ITS CULTIVATION AND PRODUCE.—Under the term AGRICULTURE are included *territorial economy*, or the improvement and management of land; and *husbandry*, or the cultivation and treatment of its more useful vegetable and animal productions.

Land, agriculturally considered, may be divided into three principal classes.

1. *Productive Land*, including corn lands of best, medium, and worst quality; vineyards and plantations of all kinds, exclusive of forest trees; productive gardens; meadows and pastures; forests, peat bogs, &c.

2. *Unproductive Land, but which may be made to produce, and*—

3. *Barren Land*, such as sands; unproductive swamps; roads, &c.

Though nature herself has, to a certain degree, established the above classification, yet the precise proportion of the three kinds of land, in any country, depends on the degree of civilization, the extent of the population, its manners, and its wants. Generally, the more peopled a country, the greater quantity of land is brought into cultivation, and *vice versâ*. The just proportion which cultivated lands bear to the population of a country depends, however, on a variety of circumstances, and can therefore be determined only after the most careful consideration of every thing which bears upon the subject. So also the relative proportions of the different kinds of culture is based upon particular elements of political economy. We shall confine ourselves for the present to directing the attention of the traveller to the observation of principal facts.

Of Productive Land.—By this term we understand all lands actually yielding, either spontaneously or by cultivation, objects useful to man; such as those which directly or indirectly supply him with food or with clothing, or contribute to his lodging, or furnish him with fuel (ex-

clusively of coal), or with objects employed in the several arts.

We will here remark, that observations on the vegetable productions of a country must be confined to such only as are or may be considered useful, either for food or in the arts, or for medicinal purposes; for these alone are important in a statistical point of view.

If it be true that the proportion of cultivated land is regulated by the population, it is no less so that the kind of culture depends greatly on the manner of living of the inhabitants. In England, a greater quantity of cattle is reared than in France, where vegetables and fruits are more abundantly cultivated than in England. In India, where the religion of the people and their belief in the metempsychosis prevents their eating of any thing which has enjoyed life, little else is cultivated for food than rice, sugar, and fruits. Climate also exercises great influence on the kind of cultivation, not merely in consequence of the peculiarity of indigenous vegetables, but by modifying in a direct manner the wants of the inhabitants. Thus, in cold countries, where wool is an indispensable article of clothing, pasturage is necessary for the feeding of sheep, whilst in hot countries a vegetable production answers the purpose, and plantations of cotton supply the place of flocks of sheep.

The spontaneous gifts with which Providence has blessed certain countries, and which she has refused to others, serve also to modify culture. England, for example, by reason of its rich coal mines, is under no necessity of cultivating trees for fuel; while in France and in Germany, the preservation and management of the forests is an object of the greatest importance.

The geographical situation of a country determines, to a certain degree, its agriculture. Mediterranean countries, deprived of the resources of maritime commerce, devote themselves more exclusively to agriculture than sea-washed countries: thus it is with Poland, its grain and its timber are its staple productions, and it cultivates but few of those objects which are directly applied to arts and manufactures.

From these remarks it follows, that the objects cultivated have only a relative importance, depending on the locality, climate, and soil, and the mode of life and institutions of a people. There are even some who do not cultivate at all, such are the nomadic tribes, whether pastors or hunters, and the fishing tribes. But let us pass on to the observations to

be made on these matters. Productive lands may be arranged according to the particular objects they produce, as grain, vines, &c., as before stated.

The first thing to be done is to ascertain, for each province in particular, how much land is laid out for each particular object, and the annual produce of each, with its cost-price and market value. These details may be collected into a tabular form. The recapitulation of the partial or provincial tables, disposed in a general table, will show at once the agricultural distribution of the land, and its productions for the whole country. Comparatively considered, the provincial tables will show the respective fertility of the different provinces, and the particular kind of culture carried on in each, with the difference in value of the same kind of articles in different places. This last species of information is of great importance in connexion with the price of manufactured articles, and of different kinds of labour in the same or in different places.

The data obtained, the traveller will next enquire into the quality of different kinds of produce in different parts of the country; he will also ascertain whether the several productions are in quantity sufficient for the consumption of the country; if they exceed that quantity, and if any is exported; or if, on the contrary, the country is obliged to import. The quantities in either case belong to the article Commerce.

What are considered the best, the medium, and the worst crops; what variations have the crops or produce undergone during a number of years, and the probable causes of such variations?

What is the highest, the mean, and the lowest price of the staple agricultural productions, whether grain or bananas, or any thing else? What variations have there been in the prices for the last ten or twenty years, and what has been the cause of these variations?

What is the annual consumption in the country of the different agricultural productions; has this consumption undergone any changes; what have been these changes, and their causes?

Although these questions apply more particularly to the staple or principal productions of agricultural industry, they should equally be put regarding every object to which they will apply.

There are, besides the general observations above alluded

to, others which are of great interest, and should not therefore be neglected; they refer to the several agricultural labours, and may be thus divided.—Preparation of the soil; sowing and planting; operations during growth; collecting or harvesting the produce; preparation of the produce for the market, &c.

Preparation of the Soil, and its different kinds.—Nature having covered the earth with spontaneous vegetation, it becomes necessary, when man would appropriate a portion of it to particular cultivation, to eradicate the natural productions, in order to substitute others more immediately useful to him; this labour is called *Clearing*, a term which, in its more confined sense, is particularly applied to the felling of forest trees and the grubbing up of their roots.

It is evident that the mode of clearing mainly depends upon the nature of the vegetation to be got rid of. There are, nevertheless, for this, as for every thing else, methods more or less perfect, either as regards the rapidity of the operations or their expense: the traveller should, therefore, observe how this first preparation of land is effected, pointing out its peculiar advantages or defects.

The land once cleared, is subsequently prepared in different ways according to its quality, and the nature of the objects to be sown or planted.

Strong lands require more working than lighter ones, in order to their proper pulverization, and more ploughings are required for wheat crops than for oats. Land that is too strong, requires to be improved by a proper admixture of sand, in order that it may not retain too much water, whilst, on the other hand, land that is too light is improved by compression, that is, by rolling or by adding a certain quantity of clay. This rule, however, is not without one exception; for certain plants, as rice for example, require a soil on which the water may remain. Some soils are so rich in the elements necessary to vegetation, that they require no improvement in that respect, while others would be almost sterile without manuring, or other processes to improve it.

The principal soils are, according to Loudon, "the clayey, calcareous, sandy, ferruginous, peaty, saline, moist or aquatic, and dry."

As it is often of great importance for a traveller in unexplored regions, to form some opinion of the quality of the soils he travels over, even when he cannot stop to examine

them carefully, we will quote from the author just named, a list of plants by which particular soils are distinguished. This list, it is true, refers to Europe, but as many of the plants mentioned grow in other parts of the world, the knowledge of the kind of soil in which they spring up may be very useful; and for countries where the vegetation is quite different from that of Europe, we would recommend to the traveller, if he is not already thoroughly acquainted with the *habitat* of plants generally, to observe as closely as possible, whenever he has an opportunity, the nature of the soils on which particular plants grow, and thus form a particular list for himself.

Argillaceous soils.—Common coltsfoot, *Tussilago farfara;* goose tansy, *Potentilla anserina;* silvery, *argentea,* and creeping, *reptans;* yellow meadow rue, *Thalictrum flavum; Carex,* many species; *Juncus,* various species; tuberous bitter vetch, *Orobus tuberosus;* greater bird's foot, trefoil, *Lotus major;* and small horned, *corniculatus;* officinal soap-wort, *Saponaria officinalis;* but the *Tussilago farfara,* is a certain and universal sign of an argillaceous soil, and is the chief plant found on the alum grounds of Britain, France, and Italy.

Calcareous soils.—Spiked speedwell, *Veronica spicata;* little bedstraw, *Gallium pusillum;* officinal gromwell, *Lithospermum officinale;* and purple-blue, *purpuro cæruleum;* clustered bell flower, *Campanula glomerata;* hybrid prismatocarpus, *Prismatocarpus hybridus;* round-headed rampion, *Phyteuma orbiculare;* Lychnitis mullain, *Verbascum Lychnitis;* wayfaring tree, *Viburnum Lantana;* common berberry, *Berberis vulgaris;* common *dwarf* sunrose, *Helianthemum Vulgare;* common pulsatilla anemone, *Anemone Pulsatilla;* white vine, virgin's bower, or traveller's joy, *Clematis Vitalba;* cultivated sainfoin, *Onobrichis sativa.*

Siliceous soil.—Three-leaved speedwell, *Veronica triphyllos;* and vernal, *verna;* Italian viper's bugloss, *Echium italicum;* smooth rupture wort, *Herniaria glabra;* and hairy, *hirsuta;* English catch-fly, *silene anglica,* and other species; red sand wort, *arenaria rubra,* &c.; cornfield spurrey, *spergula arvensis;* hybrid poppy, *Papaver hybridum,* argemone, &c.

Ferruginous soils.—Common sorrel, *Rumex Acetosa;* and sheep's sorrel, *Acetosella.*

Peaty soil.—Bilberry, *Vaccinium Myrtillus;* Bleaberry,

uliginosum; cranberry, *oxycoccus palustris;* heath, *Erica;* awl-shaped spurrey, *Spergula subulata;* officinal septfoil, *Tormentilla officinalis.*

Saline soil.—Glasswort, *salicornia;* marine wrack-grass, *Zostera marina;* sea ruppia, *Ruppia maritima;* sea lung-wort, *Pulmonaria maritima;* Soldanella bear-bind, *Calystegia Soldanella;* whorled knotgrass, *Illecebrum verticillatum;* sea goose-foot, *Chenopodium maritimum;* and shrubby, *fruticosum;* Kali salt wort, *Salsola Kali;* whorl-leaved honeywort, *Sison verticillatum;* marine sandwort, *Arenaria marina*, &c.; fringed orache, *Atriplex laciniata.*

Aquatic soil.—Marsh marigold, *Caltha palustris;* common mare's-tail, *Hippuris vulgaris;* common butterwort, *Pinguicula vulgaris;* European water-horehound, *Lycopus europœus;* diœcious valerian, *Valeriana dioica;* Marsh violet, *Viola palustris;* Valerandi's brook-weed, *Samolus Valerandi;* Marsh thysselinum, *Thyssellinum palustre;* square-stalked epilobium, *Epilobium tetragonum;* willow lythrum, *Lythrum Salicaria;* tongue-leaved crowfoot, *Ranunculus lingua;* and spear wort, *flamula.*

Very dry soil.—Red sand-wort, *Arenaria rubra;* sheep's sorrel, *Rumex Acetosella;* wild thyme, *Thymus Serpyllum;* common acynos, *Acynos vulgaris;* field trefoil, *Trifolium arvense.*

"These plants are not absolutely to be depended on; they are even sometimes found in soils directly opposite. Still the cultivated sainfoin *Onobrychis sativa* is almost always an indication of a calcareous soil; the common coltsfoot *Tussilago farfara*, of blue clay; the red sandwort, *Arenaria rubra*, of poor sand; and the sheep's sorrel, *Rumex acetosella*, of the presence of iron or of peat. The common reed, *Phragmites communis*, and the amphibious polygonum, *Polygonum amphibium*, grow on alluvial soils, which yield excellent crops if properly drained; but where the corn horse-tail, *equisetum arvense*, grows freely, it indicates a cold and retentive subsoil. The cornfield pimpernel, *anagallis arvensis*, the cornfield madder, *Sherardia arvensis;* the corn field gromwell *Lithospermum arvense*, and the salad lamb's lettuce, *Valerianella olitoria*, grow on cultivated lands, where the soil is a strong black loam on a dry bottom; when such a soil is wet, the clown's all-heal *Stachys palustris*, makes its appearance. A light sandy soil is known by the presence of the purple archangel, *Lamium purpureum*, and the shepherd's purse, *Capsella bursa pastoris.* If the parsley

piert *Alchemilla aphanes* is found, the soil is rather unproductive; if the cornfield spurrey *Spurgula arvensis* grows very thick, the ground is too fine; the common ragwort *Senecio Jacobœa* and the cornfield cirsium *Cersium arvense,* grow indiscriminately on light and strong loams, but always indicate a fertile soil. The wall draba *Draba muralis,* and the annual knawel *Scleranthus annuus* grow on soils that are dry, sandy and poor in the extreme. The spiny rest harrow *Ononis spinosa,* is often found on dry pasture, and where the soil is incumbent on rotten rock. The aquatic, peaty, and saline soils, are almost every where indicated by their appropriate plants."

So much then for soils as indicated by the plants which grow upon them. When they are to be employed for particular purposes they will require to be prepared accordingly, and have their several defects corrected by various processes, such as aeration or turning up and allowing to lie fallow; by altering the constituent parts of the soil; by paring off the upper stratum to come at the good substratum; by draining, or irrigation as required; by burning; and by the application of manures* of different kinds.

In the tillage of land the greater or less tenacity of the soil modifies the construction of the ploughs† intended to turn it, of which there is a great variety.

The observations of the traveller must therefore be directed to all these objects. The modes of clearing; the nature of the soil; the modes of tilling for different kinds of corn, vegetables, or other productions; the quantity and kind of manure; the processes of irrigation, or of draining; the implements used in the several processes; and the time of the year when the operations are performed.

Sowing and Planting.—For every thing sown, observe whether it is done by hand, by broad casting, or by dibbling, or whether machines are employed, and of what kind. Does the seed undergo any preparation before sowing?

In the case of plantations, ascertain the age or the growth of the objects planted; the depth at which they are inserted; the distance and order of the spaces; and, whether for sowing or planting, note all that is worthy of attention in the modes of operating, and the times of the year when these labours are performed.

Operations during growth.—How and at what time of

* See *Manures.* † See *Implements.*

the year are the several operations of thinning, weeding, propping, watering, &c., performed? that is to say, observe generally all the various operations performed during the growth of cultivated plants of whatever kind they may be, in order to insure the crops, or bring them to as great perfection as possible.

Collecting or Harvesting.—How are the crops of various kinds collected, is it by hand labour, as in the case of cotton gathering, the pulling up of flax, &c., or by means of implements, as for corn, hay, &c., and, in the latter case, of what kind are the implements? What is there worthy of notice in the manner of gathering or cutting the crops; how are they immediately disposed of; are they allowed to lie on the ground to dry or to ripen, and if so, how long do they lie there; or are they piled in the fields, and in what way; or are they taken to the homesteads to be stacked, or placed under ground, or in barns, or otherwise; how are they carried; by men or animals, or in carts, and if the latter, what is the construction and load of these carts? In what months of the year are these operations performed?

Preparation of the produce for the Market.—How is the thrashing performed; is the grain trodden out by horses, or is the corn thrashed by flails, and if so, how is the floor constructed on which it is thrashed? Is the thrashing performed by machinery, of what kind, and what is the moving power? Is it customary to thrash out all the corn at once, or only as required; what is done with the straw? How is the winnowing performed, by merely throwing up with shovels against the wind, or by machines? How is the hay prepared for market: in trusses or in loose loads? What preparations do all the various products of agricultural industry undergo to fit them for the market, &c.

GENERAL REMARKS.—The traveller should observe generally and particularly, according to the importance of the object, the kind of soil and aspect best fitted for different vegetable productions, together with any other details, besides those we have mentioned, which may appear of interest; such as whether the land be tilled by hand or by the assistance of horses, or mules, or oxen; how the teams are yoked; and what are the advantages or defects of the method. Notice should also be taken of the kind of weather chosen for opening the ground, for sowing or planting, for reaping, &c.; as different kinds of land, and different productions, require that attention should

be paid to this circumstance. In fine, the traveller should carefully enquire into the advantages or defects of the system followed in the usual agricultural operations, and the improvements of which they appear to him susceptible.

PRICE OF LABOUR AND VALUE OF AGRICULTURAL PRODUCTIONS.—What is the cost, including seeds and shoots, &c., of the several operations we have enumerated, separately and together, as far as they are required for each different vegetable production? This cost compared with the market price will show the profit. The value of the several productions, however, is composed of a number of elements, and is not, therefore, so easily obtained.

The value of agricultural produce is made up of all the partial values consumed in its production. The value of the land is estimated by the interest of the purchase money, or the rent paid; the value of the agricultural implements, is ascertained by a calculation of what they cost, the time they last, and the necessary repairs of them; the value of men's labour is what it costs, either by the day or by piece work; the value of animal labour is compounded of the interest of the capital expended in their purchase, and the cost of their food, besides which the capital is lost when they die. All these values which are consumed, together with the price of seed, or shoots, or young plants, &c., are reproduced in the produce obtained; the cultivator adds the value of his own time and superintendence, the payment of which constitutes his profit; the sum of all these values taken together, including the profit, composes the real value of the production or the amount for which it is offered for sale.

It is evident, however, that in calculating exactly after this manner, the cultivator would be a loser; for there are several days in which neither men nor animals are employed, though the former are still paid, and the latter still fed. Accidents also happen to the implements which renders necessary the purchase of new ones before the usual time; cattle die; the buildings required for the purposes of husbandry need repairs, &c., so that in fact the calculation must be founded on masses and not on details. These masses are the annual cost of the land and the taxes, and the general expenses, and the interest of the fixed capital. Information on these matters is hardly to be obtained

but in civilized countries, and then the cultivator must himself furnish it, as otherwise the traveller can never obtain the requisite data on which to found a satisfactory calculation.

MEADOWS AND PASTURE GROUNDS.—With regard to meadows, the traveller should distinguish between such as are natural and those that are artificial. As for the latter, he will note the kinds of grasses that are cultivated, and all the details of their cultivation, and for both kinds he will note the attention paid to them, the quantity of hay annually produced, its quality and value, as also the quantity of land occupied by each of the two kinds.

As for pastures, by which we mean particularly the short grass of high and otherwise barren lands, the observer will note the number of cattle of different kinds usually turned out upon them, and the quantity, if ascertainable, of such lands in the country.

After having paid due attention to those objects of the vegetable kingdom which serve more immediately for the nourishment of men and animals, it will be necessary to make detailed observations on those vegetable productions which are in any way useful in the arts. The order to be followed in this matter will of course be that of the relative importance of these productions in the country under examination; as for us, it is of little importance which we speak of first.

FORESTS.—A subject of the greatest importance in civilized countries is timber, whether it be required for civil or naval construction. It is from the largest trees of extensive forests that we are provided with timber fit for the keels, masts, yards, &c., of vessels, and for the large beams, &c., required in the construction of edifices. We may, however, remark, that very small pieces of wood enter into the construction of ships; but they are for the most part obtained from the bends and branches of large trees. Besides timber, properly so called, there is plank-wood of different dimensions, called deal, and batten-wood, firewood, &c.

Almost every country, more or less, can furnish a certain quantity of large timber and smaller wood, both for civil and naval constructions; but some countries produce just what is necessary for their consumption, others have not a sufficiency, and others again supply enough for an extensive exportation. The observer will therefore note :—

How the country he is considering stands with regard to the quantity of timber it can furnish. In the tabular view of the general distribution of land as regards its quality and productions, the quantity of forest land in each province and in the whole country will be laid down; but other details are here necessary, and we shall state at once all the observations to be made on the forests, though several of the objects, after information upon them is acquired, may be properly arranged under other heads. What is the name and position of the several forests, and the kind of trees of which they consist; do they belong to the government or to private individuals?

What are the kind of trees which, being indigenous to other countries similarly situated, do not grow in the country under consideration?

What are the indigenous forest-trees of all kinds growing in the country, and what exotic trees being introduced, thrive?

What are the most common forest-trees of the country?

Is the felling of forest-trees subject to any particular regulations; and, if so, what are those regulations? In some countries, the forests, according to the kind of trees, are divided into portions, only one of which can be cleared annually, which portion must be immediately replanted or sown, so as to procure a constant supply of timber. If there are no regulations, as to the felling of timber and its reproduction, the consequence will naturally be an eventual failure of the article, in a longer or shorter time, according to its consumption and the extent of the forest. To what extent may the forests have been destroyed, within a given term of years, by this want of system?

Are the forests felled exclusively for the sake of the timber, or merely for clearing the ground, and obtaining land for cultivation, as in newly settled forest-lands?

The mode of felling in the one case is careful, and the trees are selected for particular purposes; in the other, the destruction is wholesale, and sometimes effected by fire. The *modus operandi*, in either case, should be carefully noticed, and the time of cutting the different trees to be used in the arts.

What is the price of standing timber of different kinds and dimensions; what may be the net annual revenue from a given extent of forests of different kinds; at what age is it customary or most advantageous to fell the different

kinds of trees; for what particular purposes are the trees felled, is it for large timber, for sawing into planks, for wheelwright's and mill work, for cask staves, &c., or for firewood?

Is any tar, or pitch, or vegetable black, or charcoal, or potash, or turpentine, &c., prepared in the forest; if so, in what quantities, and of what value, and what are the processes? Are any of the trees stript of their bark for tanneries, &c.; and if so, what are the kind of trees so stripped, and what amount of bark is annually sold? What is the annual consumption and exportation, if there be any, of these several articles; what is the price, on the spot, of a given weight or measure of the several objects enumerated? Is the trade in them subject to any particular regulation, and what?

Is there a forest department for regulating everything respecting the forests of the country? How is this department organized, and what is the extent of its attributions?

Do the forest laws extend to private forests as well as those of the crown or state, and are these laws alike for all parts of the country, or are there, in this respect, any privileges belonging to certain places; and if so, what are those places, and what are the immunities or privileges they enjoy? What is the general effect of the forest laws of the country?

Do the forests yield any revenue to the state, and what is its amount? Is it derived solely from the sale of timber and other vegetable products of the forest, or from hunts, fisheries, peat-bogs, quarries, &c.? Is any revenue derived from wild honey, from right of pasturage in the forests, from wild nuts, collected either for oil or feeding cattle, &c.?

What are the wild or rare animals found in the forests of the country?

Besides timber for building and similar purposes, the forests often furnish trees and shrubs of particular kinds, used by turners or by joiners for works of marquetry, &c. If they possess, in an eminent degree, the requisite qualities of hardness, firmness of grain, tenacity, colour, &c., they form an object which is sometimes of considerable consequence, as is the case with many American fine woods. Where these beautiful woods are known to exist they are turned to account, but in unexplored forests they must be sought for: this latter observation applies equally to all the

productions of a country. It is also from the forests and wild places that many of the vegetable productions employed in dying and in medicine are obtained. They deserve particular attention, and may as well be mentioned here as elsewhere; though it will be advisable to place the information obtained under the proper heads to which it belongs.

DYING PLANTS.—Specify the several dying plants of the country, arranging them either alphabetically, or according to the colour they furnish, or otherwise. When the plants are known, it will be sufficient to name them according to the system of nomenclature the traveller may have adopted (stating, however, what that is) and giving, at the same time, the local names of the plants and the colour they furnish; and if the extraction of the colouring matter present any thing remarkable, it should be carefully described. It may so happen that although the plant be itself generally known, its colouring properties may be known only to the inhabitants of the country or of some particular spot: in this case, the traveller should ascertain what are the particular parts of the plant employed, what is the process followed, and the colour obtained. If the plant be altogether unknown, it should, as in all cases of an unknown vegetable production, be described in the minutest manner possible (the instructions for doing which will be given elsewhere). A list should also be made of all the plants capable of affording a dye, and which are not used, stating their quantity and place of growth, in order to engage attention towards new sources of industry and profit. Having named the several plants growing spontaneously and cultivated, and the colours they furnish, the quantity of the annual produce should be stated and its value; as also whether the country furnishes sufficient for its own consumption only, or whether it exports, or is obliged to import, and in either of the latter cases, to what amount. In the case of importation, might not the tribute thus paid to other countries be avoided by introducing the cultivation of such plants as are not produced in sufficient abundance, or are altogether wanting? Of course it must be ascertained whether the soil and climate are favourable to the culture of the plants recommended; and if so, the mode of cultivating should be indicated.

MEDICINAL PLANTS are found in all situations; they are met with in the woods, in the fields, in the marshes, on the mountains, and in the plains, on sands, and in the water. Thus nature has spread out on the surface of

the earth the vegetables necessary not only for food, for fuel, and for clothing, but also the medicines which are necessary for curing the diseases to which men and animals are liable. The following are the observations which should be made on medicinal plants: they should be made for each province separately, and then combined into a general account :—

What are the medicinal plants which grow spontaneously in the country; and what are those that are cultivated? Are the latter solely destined for the consumption of the country, or in part for exportation; if so, what are the kinds and quantity exported? In speaking of medicinal plants exported we confine ourselves to those which are employed, or at least sent, in their natural state, as roots, woods, leaves, seeds, &c.; as for gums, resins, &c., procured from the vegetable kingdom, and used in medicine or the arts, they come under the general head of VEGETABLE PRODUCTIONS, and are known under the name of drugs.

What are the medicinal plants and herbs imported, and which might be cultivated in the country; whence do they come, and to what amount? As for those that grow naturally in the country, are they all in sufficient abundance, or should the cultivation of any of them, and which, be increased?

The traveller, in enumerating the various objects furnished to the *materia medica* by the vegetable kingdom, may place them alphabetically or in any other order; but as the principal object is to ascertain how far and in what proportion the country produces the necessary medicinal plants, it would be well to arrange them according to their specific virtues, as :—

Astringent,	Expectorant,
Tonic,	Emetic,
Emollient,	Cathartic,
Corrosive,	Aperient,
Stimulant,	Diuretic,
Narcotic,	Diaphoretic,
Refrigerent,	Emmenagogue,
Antispasmodic,	Vulnerary,
Solvent,	Depurative,
Attenuant,	Febrifuge,
Acid,	Vermifuge,
Antacid,	Phrodisiac,
Antiseptic,	Antiphrodisiac,
Errine,	Poisonous,
Sialogogue,	&c.

Under each of these heads the several plants should be arranged which possess in an eminent degree the qualities indicated by the heading, placing them in succession according to the order of their powers. Thus, under the head *Tonics*, the most powerfully tonic of the plants furnished by the country should stand first, the next most powerful next in order, and so on in succession. Many plants have several properties ; thus, *Nicotiana*, or tobacco, is at the same time narcotic, salivary, expectorant, and cathartic ; but, in cases of this kind, the plant should be placed under the heading descriptive of its principal virtue.

This arrangement of the medicinal plants found in a country has the advantage, when coupled with an account of the diseases which are most frequent, of showing at once the relation subsisting between the local maladies and their natural cures.

OLEAGINOUS, TEXTILE, AND OTHER PLANTS.—Besides the dying and medicinal plants, there are many others of great importance in the arts, as those from which oil is extracted, and those whose fibres are or may be spun and wrought into tissues of various kinds. These are worthy of great attention, and observations should be made on the various plants of this description ; their quantity, quality, culture, and the value of the annual produce.

FRUIT TREES also are an object not to be neglected. The fruit of many countries is an object of very great commercial importance ; and where this is the case, every thing regarding the fruits, and the trees bearing them, should be minutely noted. The kind of details given respecting the tinctorial and medicinal plants will suffice to indicate the nature of the observations to be made on all objects of a similar nature.

ORNAMENTAL PLANTS AND SHRUBS.—We have said, in speaking of the observations to be made on the vegetable productions of a country, that those only were worthy of particular notice which were useful ; this would seem to include those shrubs and plants whose only merit is to please the eye by their forms, or by the beauty or singularity of their flowers, or to regale the sense by their delicious odours. But the old commerce of the Dutch in tulips, and the value set, even at the present moment, on many exotic flowers and shrubs ; the extent to which roses are cultivated in the East, for the perfumed water and the precious oil obtained from them, sufficiently shows, that in certain cases, the merely agreeable plants, are worthy of

more attention than they generally receive from the traveller, who too often confines himself to a bare mention of such as he meets with along his path.

Whenever the traveller shall find, in the country over which he roams, any trees, shrubs, or plants which excel, by the beauty of their forms, the colour of their leaves or flowers, the perfume they exhale, and the duration of their charms, he should point them out, enter into details regarding them, and make known the nature of the climate, soil, aspect, and culture they require.

But in order that those who are not perfect botanists may yet be enabled to give a tolerably perfect description of a plant of any kind that may be unknown, we shall give a list of the parts that must be noticed; remarking, however, that the description should always, if possible, be accompanied either by a detailed and coloured drawing, or by a dried specimen.

Parts of a Plant which should be examined and described:—

Herbification.	1. Root.		
	2. Stem.	Main branches. Minor ramifications.	
	3. Leaves.	Petiole. Sheath. Stipules. Veins. Appendices.	
Florification.	4. Flowers.	Peduncule and Pedicels. Bracts, Spaths. Sex.	
	5. Calix.	Tube. Sepals.	
	6. Corolla.	Tube. Disk. Petals.	
	7. Stamens.	Filaments. Anthers.	Lobes. Connective. Pollen.
	8. Pistil.	Disk. Ovary. Style. Stigma.	Cells. Ovules.

- Fructification.
  - 9. Fruit.
    - Persistence of floral parts.
  - 10. Pericarp.
    - Epicarp.
    - Sarcocarp.
    - Endocarp.
    - Cells.
    - Dissepiments.
    - Valves.
    - Columella.
    - Placenta.
    - Umbellical cord.
    - Aril.
  - 11. Seeds.
    - Hilum or eye.
    - Integuments.
    - Albumen.
    - Embryo.
      - Radicle.
      - Cotyledons.
      - Plumule.
- Accessory Parts.
  - Pubescence.
  - Thorns.
  - Spines.
  - Glands.
  - Tendrils, &c.

The proper examination and description of a plant in detail, as above, is what is termed a universal or complete description; such description, however, can be given only by a botanist who thoroughly understands the meaning of all the terms, and the importance to be attached to the minute examination of every individual part of a plant. The traveller who would wish to describe a plant in detail, without having previously studied the subject, may still do a great deal with the help of such works as Mirbel's Vegetable Physiology, and the *Botany*, published by the Society for the Diffusion of Useful Knowledge, and other works of a similar nature.

It must be remembered that, when a complete description is to be given, all the parts of a plant should be separately considered under four different points of view: 1st. their form; 2nd. their insertion; 3rd. their number; and 4th. their proportions. Every part examined must be perfect, otherwise errors will be the consequence. Thus the structure of a flower should be considered at the time of the bursting of the anthers; and, in like manner, the real nature

of a fruit or pericarp should be studied on the hardly developed ovary, as many parts become obliterated during growth.

The greater number of travellers, however, confine themselves to general descriptions, which are, of course, more or less satisfactory according to the knowledge and sagacity of the describer. In all cases, specimens of the plant should be obtained, though nothing is so good as a perfectly exact coloured drawing, with the minute parts magnified, and exhibited in all their details; for dried plants are often not to be recognised, and many interesting parts become obliterated by the drying, or their forms quite altered, or they crumble off and are lost.

To the detailed description or drawing of a plant, should be added a notice of the exact spot where it grows spontaneously; the climate, the aspect, and the soil; its progressive development, and how it should be cultivated, &c. These several details may be registered in a tabular form.

Besides the vegetable productions of which we have spoken, there are many others which serve for food or otherwise; they should be attentively noticed, and every information obtained respecting them, such as spice-bearing plants, &c., as cinnamon, pepper, ginger, sugar, grapes, olives, tobacco, &c.; plants cultivated or used exclusively for feeding useful animals, should also be noticed, as mulberry-trees for silk-worms, the opuntias for the cochineal insect, &c. In a word, having obtained all the information possible regarding the raw vegetable produce of each province, and of the country in general, the statistical importance of these objects may be advantageously shown by the tabular form.

UNPRODUCTIVE LAND.—We have yet a word to say on unproductive land, which may be brought into cultivation. In every country, land of this kind is to be met with, and it is often desirable that it should be cultivated; as, for instance, when, from increase of population, the land already tilled is not sufficient; or where the soil and climate are particularly favourable to the production of some article of commerce, the demand for which has increased; or where the land, being cleared and cultivated, would, by its produce, increase the general wealth of the country, and the well-being of its inhabitants. On this subject, therefore, the traveller should inform himself whether

there was formerly more land cultivated than at present; and, if so, what has been the cause of this. Would there be any advantage in cultivating land that is now unproductive; of what kind is this land; where does it lie; what kind of cultivation is it particularly suitable for; and what steps should be taken to encourage its being brought into cultivation?

As for land that is absolutely sterile, it should be mentioned as to its quantity and situation, and the obstacles to its cultivation.

Roads should be regarded as unproductive land, in an agricultural point of view; though, without a sufficiency of well-conditioned roads, neither agricultural nor any other industry can flourish. Their whole superficial extent should therefore be mentioned, in order to have it as an element in the calculation of the general distribution of productive and unproductive land; and to show, at the same time, how far attention is paid to an adequate facility of communication (see *Roads*, Art. COMMERCE).

We must trust to the sagacity of the traveller for observing a number of objects regarding land and its immediate productions, which have escaped us, or which we could not mention without swelling our volume to an inconvenient bulk.

MANURES.—In order to increase the fertility of the soil, it is in most cases necessary to restore to it those nutritious elements which it had supplied to vegetation. This is done by means of manuring. Manures are very different, and the choice of them depends upon the nature of the soil on which they are to be used, and the crops to be obtained. To enter into details on this subject would be too long; it will therefore be sufficient to remind the traveller, that manures are of four kinds: 1st, mineral, such as marl, gypsum, lime, salt, &c.; 2nd, vegetables, as the parings of peat bogs, ashes, soot, green vegetables, decayed vegetables, sea-weed, &c.; 3rd, animal, as dung of different animals, human fœces (which, however, must be first prepared), bones, fish, offals, &c.; and 4, composts of various kinds, or mixtures of the several other sorts of manure. Each of them has its peculiar advantages and, as we have said, its particular applications.

The observer will note the kind and quantity of manure used in different cases, the modes of collecting, of preparing, and of using it, &c.

ANIMALS EMPLOYED IN TILLING.—The choice of animals for tilling is by no means an object of indifference. It is true that there is sometimes no choice, and that people must employ what they have; nevertheless, when the choice may be made between oxen and horses, we entirely agree with Lord Kaimes in preferring the former; for, as he says, "They are cheaper, they are maintained at less cost, their harness is less expensive, they do not require to be shod, and the dung they yield is much better than that from horses. Horses are besides, more subject to sickness, and when sick or old, they are useless. The horses necessary for a farm must be renewed every ten years; whereas the requisite number of oxen may be always kept up without incurring fresh expense, for when they are no longer able to work, they are fattened for the market, and their value is obtained. A horse is not more docile than an ox, nor does a team of the latter require more drivers than one of the former. The Dutch, at the Cape of Good Hope, use oxen for tilling, and they accustom them easily to a quick pace, so that they are equal to horses for ploughing or any kind of draught. The inhabitants of Malabar use oxen for draught and carriage, and no other beasts of burthen are used in the neighbourhood of Pondicherry. The Greeks and Romans used oxen exclusively for tillage." To which we may add, that in the East Indies oxen are used for the artillery.

Kaimes goes on to state other great advantages attending the use of oxen instead of horses, for the labours of the field, but we cannot here go into these details though they are very important.

The traveller will notice what animals are used for the different kinds of agricultural labour, and the mode of harnessing them, together with their number and the advantages or disadvantages of the system adopted.

IMPLEMENTS OF HUSBANDRY.—These are very various, not only in different countries but in different provinces of the same country. They may be conveniently arranged under different heads, as implements for tilling, for reaping, for thrashing, &c., as spades, hoes, ploughs, harrows, rollers, sowing and dibbling machines, scythes, sickles, rakes, flails, thrashing machines, &c.; for transport, as hand and wheelbarrows, trucks, carts, waggons, &c.; for the cutting of trees and training of hedges, as axes, bills, hatchets, pruning knives, saws, shears, &c.; for fruit and their produce, as baskets, presses, tubs and casks, &c.; for the stables, as

troughs, mangers, corn bins, chaff-cutting instruments, pitchforks, &c.; for the dairy, as churns, pails, pans, cheese presses, &c.

In countries but little civilized, many of the implements made use of are of the simplest kind, but are often so ingenious, and answer the purpose so well, as to be worthy of imitation. But in all countries, whether civilized or savage, the implements of husbandry are worthy of the utmost attention.

Ploughs.—These are of all implements the most important. The use of the plough is to cut, turn up, and divide the soil as much as possible. The more perfectly the instrument performs this duty, the better it is, provided it be neither too large nor too heavy. The advance of a plough, its easy entrance into the ground, the uniformity of the furrow it makes, the facility of guiding it, depend almost wholly upon its perfect construction.

The nature of the soil, and the particular object for which it is ploughed, require not only considerable variety in the dimensions and form of ploughs, but also the shifting of some of their parts in order that the ploughman may arrange them according to circumstances.

One of the chief objects is to be able to increase or diminish the angle formed by the beam and coulter. In swing ploughs, the more open the angle the greater the depth of the furrow; in wheel ploughs, on the contrary, the depth of the furrow is regulated by the position of the wheels with regard to the beam.

When, as is in some countries the practice, particularly when oxen are used, the beam rests immediately on the yoke, the depth of the furrow is regulated either by the setting of the coulter in the beam or by making this latter project more or less beyond the yoke in front.

The form of the coulter, the plough-share and the mould-board are very important. The earth is so much the more perfectly turned over as the form of the latter is more perfect. The position and form of the handles are also important, as well as the kind and quality of the wood and iron used in the different parts of the plough.

It would be foreign to our plan to enter into the detail of all the different kinds of ploughs, from the most simple to the most complicated; suffice it then to say, that besides a close observation of the construction of the different ploughs in use, attention should be paid to teams and to the mode

of yoking; noting the advantages or inconveniences that the several objects may present, and stating the value and ordinary duration of the plough.

Harrows and rollers also differ in their construction; their use is to rake and clear the ground, or to break the clods and slightly bury the grain. In some places the teeth are of iron, in others of wood; in either case the framework into which the teeth are set, should be perfectly dry, or when it contracts, the teeth will be loose and fall out.

The construction of the harrows, the mode of using them, their price and durability, should be noticed.

Sowing Machines are all more or less complicated; their use is to distribute the seed-grain equally, expeditiously, and economically, and to cover it at the same time. The use of these implements came originally from China, where they are used for sowing rice. At one time they were much in use in England and in France; but are now generally abandoned; they may nevertheless be still used in some countries, and if so, their construction should be examined, and the advantages, if any, they afford, over the usual mode of broad cast, or other sowing and dibbling.

Scythes, whose particular use is for grass-cutting, are also extensively used for cutting grain, particularly rye; the form of the scythes in different countries should be noted, and the dimensions and quality of their blades, and where these are manufactured, and their price.

Sickles are also well known implements, whose form and size are different in different places; they should be observed, particularly as to the convenience or disadvantage of their form, and the quality of the blade.

Flails are still much used, though on large farms the thrashing machine now supplies its place. When flails are used, their dimensions and weight, and the kind of wood they are made of, should be noted. With regard to thrashing machines, the observer should note the quantity of corn they can thrash out in a given time, and whether the motion be communicated to them by steam, by wind, by water, or by cattle, &c.

Rakes, *Spades*, *Hoes*, and the numberless other implements used in agriculture, should all be noticed, particularly if there be anything peculiar or particularly advantageous in their construction.

Carts and Waggons.—Every thing regarding the dimensions and construction of these should be observed, as

also the weight they can carry without danger of breaking. In some countries, very large vehicles are used, drawn by a number of horses or oxen; in others, single horse carts are preferred; both have their advantages and disadvantages, many of which depend on locality and the nature of the roads over which the carts are destined to travel. Observe particularly how the wheels are constructed, and if the horses or cattle are yoked in the most efficient manner.

Implements in general.—It would be fastidious to name the many hundred implements necessary to agriculture, husbandry, and the various labours of the farm. Once for all we would recommend that the traveller notice regarding them anything he may deem worthy of attention.

FARM BUILDINGS.—The appurtenances of a large farm, independent of the house in which the cultivator resides, are very numerous. In Europe, they consist of barns, granaries, stables, coach-houses, cow-houses, dairies, sheds, forge, carpenters' and wheelwrights' workshops, store-houses, pigeon-houses, dog-kennels, pig-styes, green-houses, hot-houses, water or wind-mill, &c.

According to the particular kind of husbandry, these several appurtenances are more or less important and extensive; while others are less so, or quite unnecessary. When grazing and the fattening of cattle is the principal occupation, cattle-sheds are more important than barns. In corn growing countries the reverse is the case. When butter and cheese are the staple of the place, immense dairies and cow-houses are wanted. In wine-growing and cider countries, press-houses, and coopers' workshops predominate, &c.

In other parts of the world where indigo, cotton, sugar, cacao, coffee, rice, &c., are grown, the homesteads of the plantations have buildings suited to these several purposes.

But be the particular nature of the buildings what they may, the kind of observations to be made upon them are the same, only modified according to particular circumstances in different places; the nature of which circumstance, the intelligent observer will soon understand, and direct his attention to accordingly: we would merely observe that a close observation of European farm buildings is of more practical utility to us; though the homesteads of the plantations, in other parts of the world, may present more novelty, and sometimes details capable and worthy of imitation in Europe.

The grand general observation to be made is, whether or not, all the buildings of a farm are well disposed as regards convenience, cleanliness, salubrity for men and animals, good supply of water, and security from fire.

These points determined, every separate building or portion of the whole, which is devoted to some particular object should be carefully examined, and the requisites being known, the traveller will observe how far the purposes are answered, and note any and every thing worthy of remark.

COTTAGES.—The dwellings of the peasantry in every country are an object worthy of the most attentive consideration. The cultivators of the soil are, in every country, the most numerous class ; and if they are wretched, it is a poor boast that luxury abounds with the wealthy few. Nevertheless, luxury and poverty are but relative terms, and the observer must be careful to distinguish between real and only comparative misery. The English labourer with his neat little cottage, smiling among roses and honeysuckles in summer, and cheered by a comfortable fire in winter, and a good substantial meal, and a good clean bed to lie down on; his wife and children well and comfortably clad, complains of poverty. Could he but see his brother peasant of Lithuania in his wretched wooden hovel, with no flooring but the ground, no food but bread such as English pigs would hardly eat, no bed but a wooden bench in summer, or the top of the stove in winter, no clothes for the hot weather but a sackcloth shirt and trousers, his feet naked, or bound round with a bit of dirty rag, over which a sandal of matted bark is tied with the same bark twisted for strings; and in the snowy months of his rude clime, a sheep's skin, uncleaned and uncleanable, though worn for years ;—could the dissatisfied English peasant see this, we say, he would think himself by the comparison a very prince.

Let the traveller then, give due weight to relative positions, and learn to judge from facts, rather than from the accounts of the discontented ; not that this discontent is to be disregarded, for in truth, without content there is no real comfort, but the discontent, where it exists, must be traced to its true cause.

The observer then, should enter the cottages of the country, and examine them as to the style of building, with a view to the convenience, comfort, and health of the inmates. Are they well roofed, well warmed, well venti-

lated, substantial in construction, kept in good repair, and furnished with all that is really necessary? Are the houses in the villages contiguous or separate; has each a garden, how large, and how are these gardens cultivated? The cultivation of flowers by the peasantry is always a good sign, for none cultivate flowers, if they have not food sufficient and time to spare.

OF FARMS AND FARMING.—We have spoken of farm buildings, we will now say a word of farms themselves. Observe then whether they are unlimited or limited in extent, either by law or custom; and, if limited, what is their usual extent? Are the farmers tenants at will, or for a fixed term, or are they of both kinds; what is the general term of the leases, and the nature of the terms?

Are the contracts inviolable; are they terminated by the death of either party, or the transfer of the property? Whether is it found most advantageous to let out the land in a few large farms, or in a great number of small ones; to give long or short leases?

What stipulations are entered into regarding the buildings on a farm and their repairs? Who provide the cattle? In countries where the peasantry are serfs, they are usually let out with the land, as they are also sold with it; and this circumstance greatly complicates the bargains, which depend more on the proportion of the serfs to the land, than on the mere quantity of the latter. The condition of farmed serfs is often very hard; and this is an object worthy of all the attention of the philanthropic observer. If the land is cultivated by serfs, what kind of remuneration do they receive; are they paid in land, produce, or money, how much in either case, and how much labour is required of them?

How are free labourers paid, and what is the amount? How do the farmers pay their rent; in money or in kind, or both?

Do many proprietors farm their own land, or arrange with cultivators for half profits?

In some countries a practice prevails of giving the crown lands for a certain number of years, in recompence for services rendered to the state. When this is the case, observe if there is much land held in this way. What are the conditions on which the grant is made, and what are the effects of the system?

Rotation of Crops.—This is an object worthy of special observation. That a constant succession of the same crops

on the same land soon impoverishes and finally exhausts the soil, has been long known; and the first result of the observation was, to allow a portion of the land to lie fallow for one or more years. This is the system still followed in some countries, where the land is divided into three portions, one of which, in turn, remains fallow; this is, however, a great loss, and observation and experiment have shown, not only that all the land may be made continually productive, or at least, for some years, but that a judicious alternation of green crops and corn greatly improve the land. Of course, the nature of the crops, depends upon soil, climate, and demand; but as there is yet much to be learned on this subject: the traveller should attentively ascertain what is the system of rotation observed in the countries he visits. Are the lands enclosed?

GENERAL OBSERVATIONS.—Agriculture is influenced by two kinds of causes, natural and artificial. The former are those depending on the nature of the soil, the aspect and the climate; not the climate as resulting from the latitude or longitude of the place alone, but that which is the result of this in combination with local circumstances. Thus, a certain height above the level of the sea, corresponds in temperature with a given latitude, and rain, so necessary to agriculture, depends chiefly on the neighbourhood of hills and the prevalence of winds blowing from off the sea, &c. Thus, not only will the productions of different places be different, but some localities are totally unfit for certain objects, and others most favourable for them. To encourage, then, the culture of any production for which the locality is unfit, is most injudicious; for while the result will generally be a failure, all the advantages that would be derived from the kind of cultivation pointed out by nature herself are lost. This reflection naturally brings us to consider what are the artificial causes which influence agriculture.

These are numerous, and the influence they exercise is either direct and immediate, or indirect, though equally real. The causes which exert a direct influence, are particularly those laws which bear immediately on agricultural industry, and more especially the taxes on land or its produce.

It is agreed generally that a tax upon the land itself is preferable to a tax on its produce; but of this we shall speak under the head FINANCE. As for the system which

regulates the distribution of land, that is unquestionably the best which favours the greater number of properly sized farms; by properly sized, we mean such as are of convenient magnitude for easy management, and at the same time sufficiently large for carrying on those plans of amelioration, which neither the capital of very small farmers, nor the extent of their lands permit. The inviolability of contracts and sufficiently long leases are two great promoters of agricultural success.

A proper estimation of the class of men who devote themselves to the culture of the soil is also a *sine qua non* of agricultural prosperity; and in countries where the government and nobles of the land stand proudly forward as the practical patrons and encouragers of agriculture, the art or science, for it is both, will flourish.

The institution of agricultural societies, whose object is to promulgate sound theories of culture, and to announce the success or failure of experiments and trials, and to distribute rewards for important discoveries or improved methods, &c.; the establishment of agricultural schools, of experimental farms, &c., are so many very efficacious means of agricultural improvement.

Nevertheless, with the exception of laws regarding the extent of farms, the duration of leases, the inviolability of contracts, &c.; the best encouragement which can be given to agriculture by a government, is perhaps of a negative character, and consists in not obstructing its development by useless and arbitrary regulations. Much will, of course, depend upon the manufacturing and commercial industry, the degree of civilization, &c., for all these things are connected.

The traveller will, therefore, not only direct his attention to the details of agricultural industry, but will apply himself to discover all the more important facts which influence its prosperity. He would do well to construct a table in order to show the extent, number, and division of the cultivated lands of the country he examines.

SECTION II.

MANUFACTURING INDUSTRY.

On the manufacturing industry of the country, the following observations should be made :—

What is the name and nature of the several arts and manufactures of the country ; the number of each kind and the number of persons employed ; the annual value of the productions ; the quantity and value of these productions that are consumed in the country ; the quantity and value of what is exported ; the kind, quantity, and value of the raw materials necessary for the manufactories of the country, which are imported and whence they come ?

The tabular form may be used for exhibiting these several data. Thus, for instance, the article *Iron* includes a great variety of different objects, and it would be interesting to know the principal uses to which this metal is applied in the country. The same may be said of several other articles. Greater details would also have the advantage of showing at once whether the principal part of the manufactured objects of the country are such as contribute to the general comfort of the great bulk of the people, or are mere objects of luxury for the rich inhabitants, or for exportation ; a consideration of great importance in examining the actual state of a people.

If deemed advisable, the objects may be further subdivided, according as the arts or manufactures employ or prepare animal substances, as flesh, grease, intestines, skins, hair, bristles, wool, feathers, bones, teeth, horns, whalebone, tortoiseshell, milk, &c. ; or vegetable substances, as wood, resins, bark, farinaceous plants, fibrous plants, dying plants, oleaginous plants, aromatics, fruits, sugar-cane, &c. ; or mineral substances, as earths, stones, salts, bitumens, metals, gold, silver, copper, tin, iron, lead, mercury, cobalt, arsenic, &c. ; or animal, vegetable and mineral together.

The observer must also note the origin of the different

manufactures and arts in the country, and how long they have flourished; the present state of the several arts and manufactures, and the degree of imperfection or perfection of the articles produced. What are the manufactures in which the country excels; and what are those in which they are behind others, and the causes in all cases? What manufactures are of the greatest importance in a national point of view; are the manufacturers employed, natives or foreigners? What are the most important changes which have occurred in the principal manufactories, and the causes of these changes? Are there any arts or manufactures carried on exclusively by foreigners, if so, what are they, and why are not natives employed? What are the manufactures and arts in which women and children are exclusively employed? What is the price of labour in the different manufactories, and the principal variations which those prices have undergone, with the cause of their variation?

In towns, districts, or particular places, inhabited chiefly by manufacturing labourers and artisans, what are the particular regulations, if any, to which they are subjected? Is there anything remarkable, and if so, what, in the mode of living, and the customs of this class of men?

What is the total annual revenue derived from the arts and manufactures, according to the most probable calculation, and what have been the principal variations in this object? What is the difference in the price of such raw materials as are supplied by the country, and those imported?

Observe every thing regarding the mode of working, the machines, the instruments and implements, &c., employed; which among them are the invention of the country, and which are borrowed, and whence? What are the particular advantages or defects which these several objects present, and the influence which they have on the quantity and quality of the manufactured objects?

Are any of the manufactories maintained wholly, or materially assisted by the government, and of what kind, and why is this? If manufactories of the same kind as those supported by the government are carried on by individuals or companies, which thrive most, and why?

What are the distinctions, privileges, and rewards granted to those who distinguish themselves by making useful experiments, by new inventions, or manufacturing enterprises?

What in general is the encouragement, if any, given by the government to manufacturing industry?

Observe particularly whether or not the manufactures of the country are conformable to its natural productions, to the nature of the climate and the genius of the people, and whether the progress of manufacturing industry be in strict conformity with its real utility to the country, or falls short of this mark, or exceeds it: what are the effects in either case, on the rural industry of the country, on the population, and the well being of the country at large?

Does the manufacture of objects of necessity tend to free the country from dependence on other countries, or, on the contrary, do local circumstances, ignorance, or negligence, tend to keep up the dependence upon others?

Observe whether those mechanical arts which war requires, as the manufacture of gunpowder, the casting of cannon, the manufacturing of muskets and pistols, of swords, spears, &c., are pursued to a sufficient extent, and if the manufactured articles are in sufficient quantity, and the quality such, that the country is in no way indebted to strangers for its means of defence; or whether any of these articles are imported; and, if so, what in particular, to what amount, and whence are they procured? Does the country, on the contrary, export such articles, what, and to what amount?

Although it be generally true, that no kind of industry will be long carried on, if it give no profit; still there are cases in which some particular manufacture may be still upheld for some certain object, though it give no profit. If there be any such in the country, specify them, and the reasons why they give no profit, and why they are nevertheless carried on?

What is the degree of perfection of which the mechanical arts and manufacturing industry of the country are susceptible, both from the natural resources of the country and the disposition of its inhabitants? What are the obstacles opposed to the attainment of such perfection, and how they may be removed?

What, if any exist, are the particular advantages and privileges enjoyed by artisans in general over agricultural labourers, or by particular artisans over others? what is the reason of such distinction; is it founded on motives of utility, or from a disinclination to alter old customs, and what is the effect of such distinctions?

Are there any associations or corporations, and what are these, or is any one at liberty to exercise his industry, where and how he pleases, and what is the result in either case ?

Are there any particular establishments for instruction in manufacturing industry, and the arts upon which it is dependent ; what is taught in them, and how are they supported and conducted ; what do they present worthy of observation, either with reference to the country in particular, or as compared with similar establishments in other countries ?

Is there any council or special board of management established for the conducting and superintendence of all that relates to the mechanical arts and manufacturing industry in general ; if so, how is this body organized ; by whom are its members appointed and paid ; what is its authority, duties, and privileges, and to whom is it responsible ?

What proportion does the manufacturing population bear to the agricultural, and to the whole population of the country ?

In maritime countries observe particularly every thing worthy of remark in the construction of vessels, the number and situation of the yards, and the number and kind of ships annually built. Does the government interfere in the construction of merchant vessels, to what extent ; and what is the result of this interference ?

Is the timber, cordage, canvass and other objects indispensable for the construction and rigging of ships, supplied by the country itself, or are these objects, or any of them, imported from other countries ; if so, which, to what amount, and from whence ?

May not dependence on others for these essential objects be lessened, and if so, what measures is it advisable to take for this purpose ?

Are there any injurious monopolies, and what are they ?

How does the government encourage the manufacturing industry of the country ; is it by rewards, by prohibiting the introduction of foreign articles ; by the encouragement given to foreign artisans and manufacturers of merit to bring their industry and settle in the country, &c. ? or does the government, on the contrary, take no particular steps regarding the manufacturing industry, leaving it entirely to shift for itself ?

Besides all these observations, whenever any particular

manufacture is to be detailed, the amount of the fixed and circulating capital engaged in it should be ascertained if possible.

By *fixed capital* is meant the money expended in the purchase or construction of the building, machinery, implements, &c., and by *circulating capital* the money laid out for repairs, for the purchase of the raw materials, the wages of workmen and servants of all kinds, firing, lighting, &c.

Cost of production.—This is the intrinsic value or necessary price of an article, and is composed of that portion of the circulating capital which was expended in producing it, together with the interest of that portion of the circulating capital and of a part of the fixed capital, together with a remuneration for the manufacturer's pains; and, if the object be taxed, the amount of such tax with the interest on the same, if paid by the producer.

This is evident; for if the manufacturer did not obtain at least as much interest for the capital he employs in this way, as he could by employing it in any other way, he would abandon his enterprise; if he did not obtain more he would abandon it, for it is not in the nature of man to work for nothing.

As for taxes, as it is of course the consumers of the article that must eventually pay them, the manufacturer makes these repay with interest the sums he has advanced to the treasury on their account; he himself contributes his share to the general taxation as a consumer of various taxed articles. The cost of production is the lowest price for which an object can be offered for sale without loss.

Market price.—This may be the same as, or higher, or lower than the cost of production; it depends chiefly on the proportion existing at the time, between the demand and the supply. When the supply is less than the demand, the price rises, and those who sell get more profit; when the supply is greater than the demand, the price falls, and those who sell, lose.

Generally speaking, the circumstances which produce a considerable rise or fall in the market price of any commodity are fluctuating, so that the usual price is the same as the cost of production which, as we have said, includes the reasonable profit of the producer. The price of transport from the place of production to the place of sale is, in all cases, defrayed by the purchaser, for if not stated, it is included in the price asked for the article.

Some articles are much more variable in price than others, and several have always a fictitious value, and fetch a much higher price than the cost of production.

The leading facts, however, of political economy should be well understood by the traveller ; should he be ignorant of them, we cannot do more here than recommend to him, the attentive perusal of those works which treat of the science.

What is the morality of the manufacturing classes ? What is their degree of instruction in drawing, mechanics, &c.?

Are any of the manufactories of the country particularly injurious to health, and if so, which, and in what way, and what might be done to remedy the evil ?

Is machinery much employed in the country, and if not, why, or would it be better if there were less machinery, considering the state of the country ?

SECTION III.

COMMERCE.

Some authors derive commerce from navigation, and pretend that maritime expeditions, first undertaken with a view to conquest, afterwards gave rise to commerce. But in this view of the subject commerce itself is confounded with one particular branch of it. Commerce is nothing more than barter or traffic carried to its greatest extent, and is therefore coeval with the infancy of society. It would be foreign to our object even to give a slight sketch of the progress of commerce from the commencement to the present time ; we shall therefore merely remark that as soon as commerce began to extend, it was found that the system of exchanges in kind was most inconvenient, and obstructive of all further progress. A common sign or measure representative of value was therefore adopted, by means of which traffic was carried on with greater facility. The circulating medium has been different in different countries and at different times ; thus shells, skins, cattle, salt, &c., have been and some

are still used. The preference was, however, early given to the precious metals, and they have continued to be the representatives of wealth to the present day, and have greatly facilitated commercial operations; but of this and paper currency we shall speak presently.

There is scarcely anything which may not be an object of commerce; thus, all raw productions of the animal, vegetable, and mineral kingdoms, and all manufactured articles are objects of traffic; so are men's services and talents, and even their liberty, in short, everything which has an exchangeable value may be bartered; even man himself, to the eternal disgrace of humanity, is bought and sold like a beast of the field.

The greater the number and variety of exchangeable articles the more extended the traffic; and in proportion to the facility of commercial operations, the objects of traffic are multiplied. Hence an extensive commerce is indicative of a proportionate degree of agricultural and manufacturing industry. The wealth of a nation is nothing more than the simultaneous and perfect development of the three kinds of industry, agricultural, manufacturing, and commercial.

The chief care, then, of a government, as far as the wealth of the state is concerned, should be the encouragement of industry; but local circumstances can alone decide as to which of the three kinds of industry shall predominate in any country. One nation is essentially agricultural, another manufacturing, and a third commercial; but a very considerable development of all three is necessary to the successful prosecution of either.

Commerce is divided, according to the limitation of its operations, into internal and external, or, as they are called, the *home trade* and the *foreign trade*, there is also the *carrying trade* and the *commission trade*. *Colonial trade*, as its name implies, is that carried on between a country and its colonies: there are also particular branches of commerce, as the corn trade, the wine trade, the coal trade, &c.

By *home trade* is understood that which is carried on between individuals in the same country, or that by which the interchange of the several productions of the different provinces of the same country is effected, either by land carriage, or by the rivers and canals of the country, when it is called *inland trade;* or by vessels along the coast, when it is called the *coasting trade.*

Foreign Commerce, or that carried on between different countries is either direct or indirect; it is direct, whenever the money or the produce of one country is exchanged for the money or the produce of another country: it is indirect when a country obtains money or merchandise by means, not of its own productions, but, of the productions of some other country.

The *carrying trade* is either limited to the mere transport of goods from one place to another in the same country, or from one country to another; or the carriers are themselves the buyers and sellers, purchasing goods at A, and carrying them to B, where they are sold, and others bought to be carried to C, where the same operation is performed for selling at D, and at D for E, and so on, till a valuable cargo is brought home to A and disposed of. The two kinds of carrying trade was long exercised exclusively by the Dutch. At the present time, most countries, but more or less according to circumstances, fetch and carry for themselves. The latter kind of *carrying trade* is often exercised with great success by enterprising American traders, who by its means sometimes realize immense profits in a single one of these commercial expeditions.

Commission trade is carried on, more or less, in all mercantile countries, and in all ports, but more especially in free-ports. It consists in buying and selling on commission, and is often connected with warehousing and other commercial operations.

Besides the divisions of commerce just specified, traffic is divided into wholesale and retail; the former carried on by merchants and wholesale dealers, and the latter by retail traders. The various departments of commerce employ a great many agents, bankers, money-changers, brokers, shipbuilders, &c.

In order to understand the commercial state of a country, it is, of course, necessary to observe everything which is in any way immediately related to it; for it is only by co-ordinating all these facts, that the observer can ascertain how far the commerce of a country is in accordance with its several institutions. The observations to be made on all these accessary matters are given under the several heads of Agriculture, Manufactures, Navigation, Finance, Banks, Roads, &c. &c. In this place we confine ourselves to commerce itself.

Home Trade.—The extent of home trade depends on two

circumstances; on general industry, and on the diversity of the productions of different parts of the same country, a diversity which, though it may exist to a considerable extent in a small country, is much greater and more marked in large empires, embracing a variety of climates, as is particularly the case with Russia. In such case the home trade may be compared to a free commerce carried on between neighbouring nations, who should have mutually agreed to remove every obstacle which might impede its progress; and thus the home trade of a great empire, if the means of communication are sufficiently multiplied and easy, possesses, if not thwarted by unwise regulations, every element of success.

The objects of traffic are either raw materials or manufactured articles; the traveller will, therefore, make this distinction, and beginning with the former, he will observe for each province in particular the quality, quantity, and price of the production which it sends to other parts of the country; noticing also the places to which the several productions are sent. The same thing should then be done for the manufactured articles.

A table might be drawn up, in the first column of which would be placed in alphabetical order (as the easiest for reference) the names of the several provinces, circles, or districts, &c., supplying the different articles; which articles, according to their nature, with their quantity and value, will be placed in the succeeding columns; after which, the names of the places receiving the articles. In the columns of remarks will be inserted the routes taken, &c. From such a table very interesting recapitulations may be made; as, for instance, collecting together the names of all the places furnishing the same article, indicating the quantities furnishing by each and the total amount, &c.?

Such a table would, moreover, show at once the whole home trade of a country and its value, as also the extent of transport and the capitals engaged in both objects. It would also show the superfluities and the deficiencies of each individual province, or in conjunction with other statistical data, the respective industry of each.

The home trade is either inland and carried on by means of rivers, canals, and roads, or coasting, by vessels of various descriptions; it would, therefore, be well to insert in the column of remarks, the number and kind of carriages, barges,

or vessels, their loads and tonnage. The original cost and the expense of repairs of these constitute the *fixed capital* engaged in the *transport of the home trade.*

In like manner should be noted, the number of horses and men employed for the transporting of goods. The wages of the latter, and the feed, &c., of the former, will constitute the *circulating capital* employed for transport alone. These two capitals added to the cost of production of the objects themselves will give an approximate amount of the value of the whole. The object of home traffic being the reciprocal exchange of the surplus production of different parts of the same country, this surplus added to what is consumed in each supplying place, will form together the whole consumption of the country of the objects furnished by its own soil and industry, and should, if the data be correct, tally with the account of the productions of the country as obtained by other and more direct methods.

If a country received nothing whatever from any other country, its whole consumption would be ascertained by the method just mentioned, but this is never the case, and consequently the consumption of foreign articles must be added in order to have the whole consumption of the country.

When any country produces articles in greater abundance than is required for its own consumption, the surplus is exported. It must, however, be borne in mind, that although a country may produce some articles in greater abundance than is required for its own consumption, still on the whole, however great may be the exportations, no country produces more than it consumes. This could be the case only when a country sold its surplus productions for money without using this money for the purchase of any foreign production, but this never happens: the fact then is, that whenever a country carries on a foreign commerce, it does nothing more than exchange its superfluous commodities for others of which it has not enough, but which may nevertheless be considered as produced by itself, since, if it had not produced by its industry wherewith to purchase the foreign commodities it could not obtain them. Thus the final result is, that no country, taking all things together, consumes more than it produces, nor produces more than it consumes. The same reasoning which holds good, as applied to foreign trade, is applicable to home trade. Every province consumes the totality of its production, and produces no more than it consumes.

Foreign Trade.—Observe whether the foreign trade be direct or indirect, or partly the one and partly the other. To obtain exact detailed information on the subject, the two kinds of foreign trade should perhaps be separated; as, however the most indirect operations of barter depend upon a direct exchange at first effected, it does not appear to us necessary to make any distinction in treating of *exportations* but only as regards the importations: these should be divided into goods for home consumption and goods for re-exportation. These re-exportations, however, except in the case of a mere carrying trade, are undertaken with a view eventually of procuring articles of home consumption. But in order to obtain as exact a balance as possible between the exportation of indigenous produce and the importations for home consumption, it is necessary to note the re-exportations of foreign produce and their ultimate returns; for this purpose tables should be constructed.

The following details should be entered, viz.: the articles of exportation divided into raw materials of the three kingdoms, and manufactured articles from the three kingdoms separately, and from any two or all of them together; the quantity and quality of these different objects; their value at the place of production, and at the ports where they are shipped; the cost of transport (if the country itself transport), together with the duties on entrance and sale at the places receiving (if paid by the sender); the cost price at the place receiving, and the market price; the net profit, &c.

In another table, should be inserted the principal details regarding importation. This table should be divided into two parts; the first, for objects intended for home consumption, and the second, for goods to be re-exported.

A separate and distinct table may be made, if necessary, for the objects re-exported and the returns obtained for them.

The recapitulations will point out the direct or primitive exportation, and the direct and indirect importation; that is, those goods which were received directly in return for home produce exported, and those received indirectly, or the final returns from re-exported foreign produce. Thus will be shown the balance of goods primitively sent and definitively received in exchange.

Tables of this kind should be made out for the foreign

commerce of every port. The result of these partial tables being then collected, should be tabulated so as to give a general view of the whole foreign commerce of the country.

These kind of tables may be arranged differently ; thus in the tables of exportation the native productions and re-exported foreign productions may be placed together, the latter being merely in a separate column under the head "*primitive value of foreign goods.*" This method does not appear to us sufficient, as it does not present the complete and separate detail of the articles furnished by the country itself ; the manner, however, of constructing these tables is quite arbitrary ; in all cases, the object should be to present all the necessary details of the foreign commerce of the country, simply and distinctly, so as to show the relation subsisting among all the parts separately and of each to the whole.

Carrying Trade.—This kind of commerce has been already explained. It is sometimes carried on to a very great extent, and every thing regarding it should be carefully noted. To countries, not in themselves extensive or rich, it is of great importance ; for its profits are certain, and in order to carry it on, it is necessary to keep up a very large fleet both of merchant vessels and ships of war, which latter, besides protecting the commerce on the seas, guard the coast, and, in time of peace, are advantageously employed in voyages of discovery, and in the formation of new colonies.

The objects of the carrying trade are more varied than any other, as they comprise the superfluities of every country.

The capital employed in this kind of commerce, does not advance the general industry of the country so much, or at least so immediately, as other kinds of commerce : nevertheless, it is much more favourable than may be generally imagined, particularly if the materials necessary for ship building are produced in the country ; in that case timber, iron, copper, hemp, pitch, and tar require to be obtained and wrought, and this gives labour to a great many. The victualling department also employs a great many hands, and different kinds of industry, as there is a very considerable demand for grain, meat, salt, liquors, &c. ; so that, independent of the immediate profits accruing from the

trade, some branches of industry at least are maintained in a flourishing condition.

Observe what is the total number and tonnage of the vessels employed in this trade, and the number of sailors. The kind of vessels and their good or bad qualities: the consumption of the several articles specified above, separating the native from the foreign produce, and the quantity, quality, and value of each. What is, on the whole, the amount of the fixed and circulating capitals engaged in the carrying trade? These details may be registered in a tabular form.

Warehousing and Commission Trade.—These are carried on more or less in all ports, but more particularly in free ports. In these, the goods brought from one country are frequently deposited till a favourable opportunity occurs for selling them, and thus extensive depôts or warehouses are necessary, and the keeping and regulating the affairs of which is an occupation of itself, sometimes very lucrative. The proprietors of such warehouses, however, often act as commercial agents, buying for one and selling for another, and often realize considerable wealth by their commission trade. They are but rarely exempt from the speculating mania, and frequently buy and sell on their own accounts.

As the profits realized by the individual members of the state are always so much gain to the country, so the profits arising from warehousing and commission trade serve, like all other increase of capital, to stimulate industry generally; the traveller will therefore do well to ascertain, if possible, the amount of benefit accruing to the country from the commission and warehouse trade.

Independent of the profits derived by the free ports directly from the great commercial operations transacted in them, these are very beneficial to the industry of the country at large, by reason of the great quantity of provisions and other articles consumed by the crews of the vessels while residing in the port, and taken out by them. Stores of every kind for the shipping are also sold to great extent.

It is not easy to ascertain precisely the amount of profit arising from the several sources, but a single glance at the port, at the extent and number of its magazines, warehouses, and yards, with the annual number of vessels and their tonnage, both native and foreign, which arrive and depart; the number of agents, bankers, brokers, &c., &c., and the general activity of the place, will give a tolerably correct

idea of the business carried on, the profits of which are necessarily proportionate.

Special Trade, we have hinted, is such as the corn trade, the wine trade, &c. Every country almost, has some staple article of commerce, which of course, is that which it produces of the best quality and in the greatest abundance. The trade in woollen cloths was long the staple of England, but it is now succeeded by the cotton trade. Wines have long been the staple of France, &c. Besides these staple articles of foreign commerce there are particular objects of home trade, such as the coal trade and others that are, owing to circumstances, objects of both foreign and home trade, such as the

Corn Trade.—This is so important as to require particular consideration on the part of the inquisitive traveller. He should therefore notice whether this trade be altogether, and at all times, free and unrestricted; that is, whether corn may be at all times imported, and in quantities unlimited but by the demand, or whether it be limited and restricted; and if so, what are the restrictions and limits. If corn be imported or exported, what kind, and what quantity annually? Does the government encourage or discourage the importation of corn; and in either case, what are the measures taken? What are in general the regulations regarding the trade in corn, and the influence of these regulations on the abundant and cheap supply of so necessary an article.

Of staple articles in general, the traveller will do well to pay particular attention to every thing regarding them.

Besides the observations which we have said should be made on commercial industry, and on particular departments of commerce, there are others relating to commerce in general or the commercial system of a country. These observations should be directed to the relations which the several kinds and departments of commerce bear to each other, to commerce in general, and to the state of the country. But as we have yet to consider different institutions and operations immediately connected with commerce, and which, being influenced by it, modify it in their turn, we shall reserve our general observations for the conclusion of our article.

CUSTOMS, OR EXPORT AND IMPORT DUTIES.—The object of custom-house duties is twofold; the increase of the revenue and the encouragement of native industry. Sometimes the latter object is wholly neglected,

but more often, native industry is injured by those very regulations intended for its advantage.

Custom-house duties are levied both upon native produce exported, and upon foreign merchandise imported. It may at first appear unwise to exact the payment of duties on exports; but when it is remembered that the merchant only advances the duty, which is eventually paid with interest by the foreign consumers, it will appear much less objectionable than the duties on goods imported, which the consumers of the country must pay. The duties on exports, however, should never be so high as to raise the price at which the goods are offered for sale in foreign ports, above the price for which the foreigner can obtain the same article produced in his own country. In some cases very high duties have been put upon the exportation of certain articles, expressly with a view to prevent the sale of them to foreigners; as is the case with certain machinery and certain natural productions which, if other nations possessed them, they would be enabled by their means to manufacture objects for themselves, which they can now get no where, or in quantities sufficient and of the necessary quality, but in the country which thus endeavours to secure its monopoly. High duties upon foreign produce, by rendering it dear, was long thought to be an infallible mode of encouraging the native productions of the articles so taxed, or, in other words, restrictions on importation were thought favourable to native industry, and high duties had all the effect of restriction without its odium. Correcter views are however now entertained on this subject, and the time, it is hoped, is not far distant when all nations will abolish prohibitive and restrictive duties. Every thing imported from another country must eventually be paid by the produce of our own industry, and in proportion as we cease to purchase we must leave off selling and producing. But, interesting as this subject is, we cannot here go into it, and must therefore refer the reader to the best treatise on political economy, where he will find the matter discussed in detail. Custom-house duties, therefore, should be regarded merely as a legitimate source of revenue; and if the articles bearing them are assessed with prudence, and the tax no way interferes with the free development of commercial enterprise, they cannot, nor will they ever, be objected to.

The custom-house establishment will, of course, be more or less extens,ive and will cost more or less to the state,

according to its organization, to the nature and extent of the frontiers and of the ports, and the extent of the foreign commercial relations of the country.

The various articles paying duty are contained in a tariff, where the names of the objects are consigned, with the amount of duty imposed upon each, by weight, measure, or value. The traveller should procure this tariff.

The particular objects to be observed regarding custom-house duties, or the customs, as they are called, are whether they are simply a source of revenue, or whether in any, and, if so, in what particular cases, they are calculated to act as prohibitions or restrictions upon importation.

What is the annual gross amount of the customs, what the expense of administration, including salaries of officers, &c., of the whole establishment; which latter sum subtracted from the gross amount, will show the net revenue, and also the proportion between the sum levied and the expense of levying the same?

What number of persons of all classes are employed in the collection of the duties, in the prevention of smuggling, &c., with the individual salaries of each? Are the salaries of the several officers and inferior servants of the establishment such as to render inexcusable any connivance with smugglers and defrauders?

What are the penalties inflicted for violation of the laws of customs, either by the persons belonging to the establishment or others?

Are frauds common, and of what kind? What are the means employed for detection and prevention? Is smuggling carried on to a great extent? What are the goods chiefly smuggled, and from, or to, what countries? How are smugglers punished, and detecters rewarded? What may be the annual amount of loss sustained by the revenue, from smuggling? What are the goods actually prohibited to be imported or exported, and under what penalties?

Is the tariff well digested, that is to say, is it founded on sound principles as regards the exigencies of the state, the propriety of assessing articles of luxury and superfluity higher than objects of necessity, the proper facilities for the importation of things wanted, and the general encouragement of the home industry? Is every thing clearly defined so as to avoid ambiguity and misconstruction, or is the reverse of all this the case?

Is the tariff often changed, and what are the most marked

consequences of the confusion arising from frequent change, want of precision, &c. ?

May the duties be paid in any port, or at any of the receiving houses along an inland frontier, or must certain objects be carried to certain places ? What are these particular objects, and the places where they must go to pay the dues ; what is the reason of this regulation and its effects ?

Where is the central establishment and the different receiving houses?

Are the registers kept with the necessary degree of accuracy ? Are all the operations organized with that spirit of order and simplicity so essential to the speedy and satisfactory transaction of business, or is there a variety of useless and vexatious formalities tending to disgust the trader and retard his operations ?

Are all nations subjected to the payment of the same dues, or if there be a difference, what is it, and why ; and what are the nations which enjoy any advantageous privileges, or are subjected to heavier duties than others ?

In a word, what are the principal advantages or disadvantages of the system of duties on foreign commerce, or the Custom regulations of the country ?

EXCISE.—Duties levied on home produce, consumed in the country, are called in England Excise duties. In all civilized countries there are duties of a similar kind, and either have some specific name or are included in the general system of taxation; now as the home produce is, after all, that of which the consumption is greatest, so the duties levied on these bring the greatest sums into the treasury. In England they amount to nearly one half of the whole revenue of the kingdom. These duties have been long considered the least objectionable taxes, if laid on with judgment ; for the consumer, who eventually pays them, is hardly aware that he does so, and although the duty falls chiefly upon the necessaries of life, it is light for each individual. But this reasoning is false, and Excise duties, unless when levied exclusively on articles of luxury, have the disadvantage of keeping up high prices and making the consumer pay twice as much more above the real value of the article than the real amount of the tax claimed by the Government. But we cannot go into these details; the traveller will therefore observe what are the objects of home consumption and produce that are taxed; if these taxes are heavy, if they bear on

all objects indifferently, or more heavily on articles of luxury than on articles of absolute necessity.

What is the annual amount of these duties and the expense of collecting? The other observations to be made on this subject are similar to those pointed out for the Customs. The principal object is to ascertain what effect the duties we are speaking of, have on the industry of the country.

MONEY.—We have said in the beginning of our article Commerce, that nothing has so much facilitated its operations as the use of a convenient medium of exchange, and measure or standard of value; and that of the different objects that have been from time to time employed, none so perfectly answered the purpose as the precious metals. Every common medium of exchange or universal equivalent is *money*, but the precious metals alone possess all the requisites of money, which are as follows:—

It must be—1. divisible into small portions; 2. be invariable in quality; 3. admit of being kept for an indefinite length of time without deterioration; 4. have great value in little bulk so as to be easily transportable; 5. have its value comparatively steady; 6. be of such matter as to be easily distinguishable from all other matter, and its quality easily ascertained; 7. have an intrinsic marketable value; 8. be of limited production, yet in sufficient quantity; 9. be susceptible of receiving an inscription or stamp certifying its purity and weight, in a word its value; and, 10. all pieces of money of the same denomination must be of equal magnitude and quality.

Coin, then, is the most perfect species of money; but as there are still some nations which have no coin, and carry on their commerce by means of some other common medium of exchange, while a few limit their operations to the direct barter of one commodity for another, so the traveller should note what is the mode adopted. Thus, are exchanges effected directly by giving one object or commodity for another; or is any particular merchandise used as a common standard of value, and, if so, what is it; and how far does it answer some of the requisites of coin? Are the metals in an uncoined state or grossly fashioned; as gold dust, metal in bars, or ingots, &c.? forms most inconvenient, on many accounts, particularly if unequal in size and bearing no stamp, regulating their precise value. Where coin is used, which implies a high degree of civilization, describe its nature and weight, degree of purity, value and divisions, the impressions

it bears, and the degree of confidence with which it circulates. Is it really of the standard declared by the Mint, or, if below it, to what amount? this is essential in estimating the rate of *par* between one country and another. Has the coin of the country ever been debased, when, to what amount, and what have been the consequences of so impolitic a measure?

Is the exportation of gold and silver coin permitted or prohibited; and if the latter, under what penalties? If coin be exported, what is the cause of this; to what country is bullion chiefly exported? Is much bullion imported, and whence? Can any quantity of pure gold or silver be at any time exchanged for an equal weight of gold or silver coin; or, besides the difference from alloy, is anything paid for coinage, and what? Is foreign coin, in general, current in the country, or only that of some particular country, and which? May coin be melted down, or is this prohibited, and under what penalty? Is there much counterfeit coin in circulation? Is there any thing particularly worthy of notice in the modes of refining and coinage at the Mint, and what?

Coin, notwithstanding its many advantages and the great value contained in small bulk, is still inconvenient when a large amount of money is to be paid, and the distance great. The inconvenience consists in the risk of loss and the expense of transport; besides which, a continual transfer of coin from hand to hand, the repeated counting of the pieces, and their friction, one against the other, wears them so much, that in time they will no longer be taken till after being weighed, an operation which the very act of coining is intended to render unnecessary. From these considerations, it was found that payments might be made with greater security, and infinitely greater facility, by means of paper.

Negotiable paper receives different names according to circumstances; but in all cases it passes current, not from having any intrinsic value of its own, but because it contains, in some form or other, a promise to pay the amount specified in legal coin, or an order to some one to pay to the *holder* of the paper, either at sight or within a given time, a specified sum in coin. Of the several denominations of paper which facilitate commercial transactions, *Bills of Exchange* for payments abroad, and *Bank Notes* for home circulation, are the most important.

Every one knows that, by the former, if A. of London owes a sum of money to B. at Paris, and C. of Paris owes an equal sum to D. of London, these several debts may be cancelled without any actual transfer of money between the two places. Thus A. of London, instead of sending money to Paris, buys of D., also in London, a bill upon Paris; that is to say, he pays what he owes to B. in Paris, to D. in London, who gives him, in exchange, an order upon C. in Paris, to pay a like sum to B., also in Paris.

Bank Notes are promises to pay, at sight, the sum specified on them; and it is from the certainty that they can, at any time, be exchanged for hard cash, that they circulate freely, and are taken and given in perfect confidence. They bear no interest, and are only circulated by authorized banks. The circulation of notes is limited by certain regulations, and by the interest of the banks. When, from any circumstance, the notes fall in value, that is, whenever the paper currency is depreciated, it is then called *paper money*, and its circulation is forced. The circumstances which caused the depreciation may continue to operate till the Bank, or the Government, who issue the notes, no longer able to pay any thing, become bankrupts, and the paper money, like the French *Assignats* first, and then the *Mandats*, become of no more value than so much waste paper, and the holders are involved in ruin. The excess of the evil, however, in some measure compensates itself, for poverty is a relative term, and when all are reduced to poverty, all are equally rich.

A forced currency applies only to the notes of Government and of the public Bank; private bankers are declared bankrupts the moment they can no longer pay in specie the full value of their notes when presented. No banks, however, can stand a determined run; that is, none are in a situation to pay in cash the full amount of their circulating notes. In the ordinary state of affairs, if they have cash to the amount of a third or a fourth of their notes, have good credit and enjoy perfect confidence, they are safe; and under such circumstances notes are equally valuable with coin, and are a much more convenient medium of exchange.

What is the value of the several bank-notes in circulation, and the gross amount of Bank or Government notes in circulation? Is the paper of the country negotiable in other countries, and which? Is it at par, or below or above par?

Is any particular kind of paper used for the Bank and other notes, and what means are taken to prevent their forgery?

BANKS are public and national, or private. Banks also differ according to the nature of the business they transact: thus, there are banks of deposit, of discount, and of circulation. Some banks carry on all these operations, some two of them, and some, though rarely, only one. Banks of deposit receive and keep for the depositor bullion, plate, jewels or other valuables, till he thinks proper to draw them out. Banks of discount advance money on bills of exchange, promissory notes, &c., before they are due, as also upon mortgage, pawn, or other security. Banks of circulation issue their own notes, as a circulating medium to be used in place of coin.

A public bank is that which is in such intimate connexion with the government, that the support of the one depends in great measure on the support of the other; or rather a public bank is that in which the government is a proprietor, or over which it has direct control, and which it uses as its instrument for the collection and distribution of its revenue. Private banks are those carried on by individuals without any connexion with the government, or any special authority or charter. In some places private banks may, and in others they may not, circulate notes.

The precious metals deposited in banks are received at a certain valuation, which is that of the new standard coin of the realm. Thus a quantity of gold or silver specie, which has been long in circulation, is of course much worn, and its value proportionately diminished. For example, ten thousand old worn guineas may have lost five per cent. of their standard value; the Bank, therefore, receives them only at that reduced rate, and credits the depositor accordingly. This difference between what is called *bank money* and the current specie is called the *agio;* and when the currency is well regulated, the agio is subject to little variation.

Letters of exchange, payable in bank money, are more easily negotiated than others.

It would be out of place here to go into detail regarding the various operations of banks and banking, operations which, unless perfectly understood, cannot be well judged of; and none can properly understand them but those who have made the subject a special study. Nevertheless, there

are a few observations which every one may make; that is, interesting information may be obtained on many points by enquiry of competent persons. These observations are as follows:—

Is there a national or public bank? What is its name, when was it founded, what is its capital, and of what does this consist; as of bullion solely, or of this and plate and jewels, land, &c.? What is the amount of its paper in circulation; what are its principal operations; what is the number of shares and their actual value; what have been the fluctuations in the value of the shares? Does the Bank give any interest on money or deposits, and what, or does it exact any payment for taking care of the deposits? On what does the security of the Bank mainly depend? Has it ever refused to pay its notes in cash; on what occasion and what were the consequences? What are the mean annual profits of the Bank? Is the Government a debtor or a creditor to the Bank, and to what amount? Has the establishment of the Bank proved a national benefit; has it at any particular time, sustained the falling credit of the Government or that of the commercial body? How is the government of the Bank organized; what number of persons does it employ, and what is the expense of administration? May foreigners buy stock in the Bank? What amount of shares belongs to foreigners? What amount of bullion or other valuables deposited in the Bank is the property of foreigners? what is the *agio* of Bank money? Has the Bank any branch banks? how many, and where situated? What number of private banks are there; what kind of affairs do they principally transact; what degree of credit do they generally, or any of them in particular, enjoy? Are failures common among them, and from what cause, &c.?

WEIGHTS AND MEASURES.—The greater number of exchangeable articles are bought and sold by weight or measure, nor is this all; measures are used in the calculation of distances of places, the determining of estates, &c.? thus the weights and measures of a country are an important object of observation for the traveller.

Measures are *Itinerary*, *Linear*, *Agrarian*, of *Capacity*, and of *Solidity*. The first are for great distances, and particularly applied, as the name denotes, for determining the length of roads. The next kind, or the linear measure, is for less considerable lengths, as for measuring cloths, stuffs, &c. The agrarian, for fields, estates, and territorial surfaces in

general; for other surfaces the linear measures are used, taken according to the two dimensions of length and breadth; and, the word *square* being prefixed, they form what is called *superficial* measure. Measures of capacity are used for liquids, and also for dry goods: as for wine and for grain, &c. Measures of solidity have sometimes particular denominations when applied to particular kinds of objects; in other cases the linear measure being taken in the three dimensions and multiplied together, the word *cubic* is prefixed to the linear denomination, whatever it may be, as in the case of square measure.

Weights are less varied than measures: the same system of weights being, with few exceptions, applicable to things the most dissimilar; nevertheless objects of great value in small bulk, or dangerous drugs, have a particular system of weights, being the smaller fractional parts of the general system; and objects of small value under great weight are weighed by a system formed of the higher multiples of the general system. It sometimes happens, however, that in a country there are different weights, as well as different measures, under the same names, as with us the *pound* troy and the *pound* avoirdupois, the wine *gallon* and the ale *gallon*, &c. This is always a cause of more or less confusion, so that a standard of weights and measures has always been deemed a most desirable object in civilized countries; but the great difficulty has been the determination of this standard, which should be invariable. A portion of the arc of the meridian has been adopted in France, and in England the length of a pendulum vibrating seconds, under identical circumstances, has been taken, if not as the standard itself, at least as a means of verifying the standard. In all cases the linear measure is the basis of all other denominations of measure, and in some places of weight also; the weight of a given measure of water, being taken as the immediate standard of weight. These remarks premised, the observations to be made by the traveller on this subject are easily deduced.

What is the system, or what are the systems of weights and measures, where there are several? What are legal and what are not? What is the standard; how and when was it determined; and how are the material models preserved, and of what are they made? What are the defects or advantages of the system, and what is the penalty for using false weights and measures? What are the proportions be-

tween the weights and measures of the country under consideration, as compared to those of the travellers' own country?

Finally, as weights and measures of every kind are of the greatest importance to the commercial transactions of a country, they form, as we have said, an interesting object of notice in connexion with commerce.

With respect to itinerary measures, they are very different in different countries, even when the name is the same; thus, an English mile is only one-fifth of a German mile, and in France there are country leagues (*lieues du pays*), and post leagues (*lieues de poste*). The traveller should be particularly careful on this head, or otherwise he will frequently be misunderstood in stating distances.

In some places it is not unusual to estimate distances by day's march. Now this day's march may be the day's march of a man on foot or on horseback, or the day's march of a caravan of camels, &c. The value of a day's march should, therefore, be exactly ascertained; besides, the nature of the country will make a great difference. The distance in a straight line, in mountainous countries, of a day's march, will be very different from a day's march in the plains. In some places, distances are counted by hours and to these the same remarks apply.

TRADING COMPANIES.—Great commercial operations require great capital, and hence it is usual for merchants to join in co-partnership; larger associations are called *companies.* Of these there are different kinds, as joint stock companies, open or regulated companies, companies *en commandite*, &c.

Joint stock companies are monopolies, and as such are often injurious to the public interest; while, notwithstanding the particular privileges they enjoy, they seldom succeed. Such as do maintain themselves for any length of time, owe their property to other sources of revenue than commerce: thus, the East India Company would long since have failed but for the territorial revenue derived from their conquests; nevertheless, they are sometimes excusable, nay beneficial, as opening a trade where individual exertion would be insufficient, and the government not in a position, or unwilling, to incur the expense, trouble, and responsibility; but their peculiar privileges should be limited, and their monopoly should cease before it becomes a public disadvantage. Joint stock companies, however, are formed not only for

direct trading, but for all undertakings requiring large capital, as the construction of canals, docks, railroads, insurances on lives or against fire, &c.; and, as we have said, when the profits are limited, in such of them as from their very nature are necessarily monopolies, their benefits to the public are considerable. The profits arising from them are more certain than in strictly commercial companies, and by the great number of them which exist, and the great number of shares into which they are severally divided, the profits are distributed among a very large portion of the public.

Open companies are not now common, but in their nature and organization they are superior to joint stock trading companies, mining companies, &c., both as regards the parties themselves and the public; for the country is by their means disburdened of the expense and trouble of regulating their public and political liabilities, whilst the utmost freedom of individual exertion is enjoyed by the members of the company, who, competing among themselves, can never combine in a measure injurious to the public interest. With regard to these, and all other companies connected directly or indirectly with commercial speculation and industry, the traveller should observe—

What companies are in existence, their particular objects, their organization, the privileges they enjoy, how long they have been in existence, what gave rise to them, their prosperous or declining state, the advantages or disadvantages which result from them to the public, &c.

MONOPOLIES. — What monopolies besides those of companies are enjoyed by individuals, and what are exercised by the crown or government? What are the reasons alleged for their establishment, and the effect they produce?

SLAVE TRADE.—As this still unhappily continues to a great extent, notwithstanding all that has been done to put a stop to it, the traveller will do well in foreign parts to obtain what information he can upon every thing connected with this most interesting subject.

COMMERCIAL NAVY.—Maritime countries alone possess what may be called a *Commercial Navy*. We shall here point out some of the principal observations to be made on this subject, and this article, together with what we have said on internal navigation (section HYDROGRAPHY, art. *Rivers*), on coasting (same section, art. *Sea*), and on fisheries, and what we shall in another section say on the belligerent navy, will complete the subject of *navigation* generally.

On the commercial navy the enquirer should ascertain, if possible, the number of vessels of each different kind belonging to the country, employed in commerce; the tonnage of the whole; how many seamen are employed, and what is the mean annual amount of their salaries. In general, what is the amount of the fixed and circulating capital engaged in the commercial navy? (of course not including the objects of traffic.) What are the relative positions and obligations established between the sailors of the navy, properly so called, and the commercial navy, in times of war and during peace? What is the difference between the pay, the provisions, the discipline, and general position and treatment of the sailors of the two services? What are the advantages or the disadvantages of the existing system?

To what particular purpose is the commercial navy of the country applied; is it for exporting or importing, or both; or is it generally, or any portion of it, employed in carrying for other nations, and which? In the latter case what may be the amount of benefit accruing from such employment of the vessels? What number of native merchant ships leave each of the ports annually; their usual destination and cargo; the routes they generally take; the time of their departure and return; the number of voyages they make annually, &c.?

Is the commercial navy directed by any special administration; if so, what is its organization, and how are the affairs conducted? Are the captains of merchant vessels obliged to undergo any examination before being intrusted with the command of vessels? Are the vessels themselves examined in order to insure their being in all respects seaworthy? Are there any schools and hospitals for merchant seamen, and any provision by government, or commercial bodies, for disabled seamen of the merchant service and for their destitute wives and children? What are the advantages and disadvantages to commerce, of the existence of such establishments or the want of them?

What have been the principal changes, progress, or decline, of the mercantile navy for the last ten, twenty, or thirty years, and to what owing? Is it, in its present state, in exact conformity with the wants of commerce and the state of the country or not, and why?

What establishments are there for insurance of vessels, their number and name, and have they any regulations particularly worthy of notice?

Are the merchant vessels armed in time of war and how; is it the custom in such times to grant letters of mark? What signal victories have the merchant vessels of the country achieved?

What are the regulations of the government regarding merchant ships employed as transports for troops, &c.?

Such and other similar observations should be made on the commercial navy; summing up the details with a general account of the actual state of the mercantile shipping interest in itself, and as regards the prosperity of the country.

ROADS AND CANALS.—*Roads.*—This subject might at first seem to belong exclusively to inland commerce, but it belongs to commerce in general; for it is evident that roads, canals, and rivers, are not only necessary for carrying from one part of a country to another the goods to be consumed in the country, but for conveying from the interior to the ports, and from there to the interior, the various objects of exportation and importation.

Commerce, then, is not only greatly dependent on the existence of a sufficiency of good roads, of canals, &c., but cannot be carried on without them. In observing roads, two things are to be considered; their line of direction and their construction. The main object in choosing a line of direction is, that the road from one place to another be as short as possible, and as even as the ground will admit. The natural obstacles of the soil are the only ones which cause a road to deviate from the straight line.

A road of any extent can hardly ever be made straight but by incurring great expense in dykes, bridges, cuts, &c.; an expense which can be borne only by countries having very extensive commercial relations. The object of having a road as straight as possible is to save time, and consequently expense, in the transport of goods and for travelling. When the road is long, it requires a long time to go over it, and consequently there is so much the more to pay in salary to drivers, for the feed of horses or other animals, and the price of merchandise is increased in proportion; independent of which, the loss of time in the arrival of goods is frequently a most serious evil.

But the transport of goods between any two places may be longer or shorter according to the good or bad quality of the road, independent of its length; so much so indeed, that in many cases the longer road may be travelled over

in the shorter time. Of two roads of equal length it is evident, that if one be perfectly horizontal, or has but a few gentle slopes, and is moreover of firm and even surface and well kept, while the other is hilly, sandy, clayey or swampy, is full of deep ruts or loose stones, the former will be traversed not only in much less time than the latter, but also with much less injury to the vehicles and beasts of draught. It is therefore essential that a road be not only well laid down as regards its direction, but also that it be well constructed and constantly kept in good repair.

We shall here draw attention to two circumstances, one of which at least appears to us of some importance, it is this. In tracing out a high road leading to the frontier of some other state, engineers do not always sufficiently consider the facility they thereby afford to an enemy who would enter the country. If, on the one hand, it be decidedly an advantage to facilitate the transport of merchandise to and from the frontier ; on the other hand, the road should be so directed as to present the greatest possible difficulties to an invading army. Every military man knows what these obstacles are, and every prudent government should take this into consideration in laying down new roads, leading from the frontiers to the principal cities and towns.

The other observation tends merely to the correction of a common error. It is generally believed that, all else being equal, the most perfectly level road is the best : now though this is certainly true for pedestrians and cattle not yoked, the contrary is the fact as regards the travelling of vehicles ; it being found by experience that a road slightly undulating fatigues drawing horses much less, and no way lengthens the time of travelling. On a perfectly horizontal road, the collars are constantly pressed against the cattle, whereas in going down hill they are relieved from this pressure, which refreshes them very much, and more than compensates for the fatigue of pulling up hill ; and the greater rapidity of the descent compensates the want of it in ascending.

We shall now say a word on the construction of roads. The surface of a well constructed road should be sufficiently convex for the water to run off, but should have no more convexity than is sufficient for this purpose. The road should be rather compact than hard ; if too hard it injures the feet of the cattle, while compactness is necessary in order that the road may not imbibe water and be deteriorated by frost.

The continued good condition of a road depends chiefly on the solidity of its foundation.

Deeply excavated roads, or such as are bordered by lofty hedges or enclosures, particularly if the roads are narrow, or by thick set trees, as when the road goes through a wood,—if they have the advantage of being cool in the hot season, they have the inconvenience of not drying speedily after the rains. In general a road should be somewhat raised above the level of the country through which it passes. The ditches must be of a depth proportionate to the quantity of water they are intended to receive, and the draining off of the water must be managed by proper slopes ; unless, as in some particular cases, it be required to keep it for the purposes of irrigation. It is perhaps more advantageous, in some cases, that the ditches should be on the outside of the hedges as regards the road, when, however, channels must be cut at short intervals to allow the water to run off the road into them. Where raised footpaths are formed for the benefit of pedestrian travellers, the earth excavated from the ditch is employed for these paths, and the ditches must therefore be on the road side of the hedge. These remarks will sufficiently point out the objects which should fix the attention of the traveller as regards roads considered in themselves.

From what we have said, it will be easily conceived that the construction and repair of roads is an object of great expense. In some countries it is defrayed by the state, in which case the executive has the sole management of every thing regarding the roads. It has been remarked, that under such a system, the high roads alone are attended to, while the by-roads, which constitute by far the greater proportion, are so neglected as to be almost impracticable. In other countries, the superintendence of the roads is confided to local authorities, chosen by and from the landed proprietors of the neighbourhood, whose interest it is, to see that the roads are kept in the most perfect state at the least possible expense. But even when such a system prevails, complaints are often heard of the negligence and ignorance of the administration.

It should be observed that when the government undertakes the construction and care of the roads, it is very apt to raise more money under pretence of covering the expense, than is absolutely necessary, and the charge is apt to vary with the particular wants of the treasury :—a state of things

most prejudicial to the interests of commerce in several ways. But when the roads are maintained by means of the traffic carried on, they accordingly, with few exceptions, keep pace, in all respects, with the extent and necessities of such traffic.

In many countries the custom still exists of keeping the roads in repair by contributions of forced labour or *Corvées:* that is, the labourers of the several villages and hamlets, are obliged to work on the roads and keep in constant repair certain portions of them, according to their population. This is a most oppressive system, because, independent of the labour itself, much time is often lost in coming and going from great distances, and the greatest inconvenience incurred, as the distance precludes the returning home till the work is completed, and the labourers are thus compelled to bivouac and often to live as best they can, no resources of any kind being at hand. In some places the right of exemption from *Corvée* may be purchased; but unless the money so raised is applied to the finding of substitutes, the labour becomes so much the more severe on the poor, who cannot purchase the exemption. This subject is worthy of the closest investigation of the traveller.

In some countries the funds for the repair of roads is collected at gates or toll-bars, established on different parts of the road. Vehicles of all descriptions, as also animals, and, in some particular cases, even foot passengers, pay a certain toll, more or less according to circumstances, and regulated by a tariff drawn up on purpose. In general the sum exacted depends on the weight of the merchandise, the number of cattle yoked, the length of the course, and is regulated by the sum required to keep the road in good repair, which sum, of course, varies in different places, according to the price of labour and materials, and to the wear of the road, &c. It is also customary to charge for vehicles of luxury, saddle horses, &c., proportionally more than for carts, waggons, packhorses, &c., employed for the purposes of trade and industry. The toll-bars are generally farmed out.

When this mode of collecting money for the repairs of roads exists, the traveller should ascertain the tariff at the different gates. Is it uniform on all roads; and if not, what is the difference, and the reason of this difference? What is the sum raised annually on each road, and on all the roads together? Is this sum just sufficient for the proper maintenance of the roads, or does it fall short or exceed

it? Are the sums raised, conscientiously applied to the roads, or is any of it embezzled? How is the administration of the roads composed, and how are its labours organized? Is the system advantageous in its effects as regards the state of commerce and industry in the country?

In countries where there are no toll-bars, how are the necessary sums levied, &c.?

Observe also if milliary columns are erected on the roads, to inform the traveller of the distance to and from the several places on the road; at what distances they are placed and how constructed. In some places they are very elegant and solid; in others, very simple and fragile. Are the indications engraved, or merely painted, and therefore likely to be effaced if not constantly attended to?

One very essential object, and greatly neglected in many places, is the establishment of finger posts or indicators, placed where different roads meet, and indicating the several places to which they lead and the distances. They are particularly necessary in forests, in plains, and all other places at a distance from any habitation. The people of the vicinity generally know the roads, but strangers often mistake them, and are thus put to great inconvenience, and a loss of time occasionally of great importance.

Inns of some kind or other are found on all the principal roads in civilized countries; but good ones can hardly be expected but on much frequented roads. In the East, it is customary for both the government and private individuals to establish hostelries and wells for the accommodation of travellers, and, near these, they not unfrequently plant trees, if the country be barren and hot, in order that wayfarers and their cattle may repose under the grateful freshness of their shade.

On the much frequented roads of rich and commercial countries, highway robberies are more or less frequent, and, in some cases, no effort of the laws can annihilate the bands that infest the highways. A safe conduct may, in some cases, be obtained by a contribution, which all are willing to pay rather than incur the inevitable risk of being robbed to a much greater amount, if not ill treated or murdered.

On these and all other subjects connected with the roads of a country, the traveller will do well to get all the information he can.

Canals.—We have already pointed out the observations to be made on canals (page 47); we would therefore merely

remind the traveller that they are mainly important in a commercial point of view, and it is, therefore, as regards the advantages which they furnish to commerce, that he should, in this place, regard them. He will direct his attention to the particular places through which they pass, or between which they form the communication; the kind and quantity of merchandise transported by their means, the price of transport, &c.

GENERAL REMARKS.—We have now directed the attention of the traveller to some of the more important objects he should observe in connexion with commerce. Other subjects of examination are of course very multiplied, and will naturally suggest themselves, as Bankruptcy, its frequency, its causes, the laws regarding it, &c.; Usury, its prevalence, and the regulations for preventing the demand of illegal interest, &c.; Forestalling, Monopolizing, &c. It now only remains, therefore, to say a word on the general remarks to be made; and which result, of course, from a careful examination and comparison of all the details of the subject.

Commercial Balance.—It may be proper here to correct a very common error. If, for instance, the importations are valued at twelve millions, and the exports at ten millions, it is generally thought that the balance is against the country to the amount of two millions, whereas it is in fact the very reverse. If money were given in both cases, that is to say, if the country A receive for what it sold, ten millions in money, and had to pay to B twelve millions also in money, for what it bought, then indeed the balance would be against A; but this is not the case. The fact is, A receives merchandise of the value of twelve millions for which it has given merchandise of the value of only ten millions, and is therefore a gainer of two millions by its commercial transactions. On the subject of commercial balance then, ascertain if it be on the whole against the country, or favourable to it, and to what amount. What have been the changes in this respect for a number of years, and the causes of these changes?

What are the natural advantages possessed by the country for commerce, or under what natural disadvantages does it labour? Are the natural advantages fully appreciated and acted upon, or not; and if not, why? May any of the natural disadvantages be remedied, and how?

Are there any regulations for promoting the interests of

commerce in general, or of any particular branch of it, and what are these regulations?

In a word, the general observations bear upon three principal objects; 1, the actual commercial system of the country; 2, the comparison of what this is with what it has been, or may be; and 3, the best means of making it what it should be.

The absolute extent of the commercial relations in themselves, is not always the most important point. The chief advantage of commerce is derived from its being in the exact proportion assigned to it by the genius of the people, their degree of civilization, the climate, the soil and productions of the country, and its positive and relative geographical position.

To enter into an examination of all the complicated details of the direct and indirect relations subsisting between these several objects would far exceed our limits. An intelligent observer, knowing the facts, will have little difficulty in drawing from them correct conclusions; and he who cannot do this, may confine himself to the mere observation of the facts connected with commerce, as we have directed.

It is an acknowledged general truth, that, in order for commerce, or any other industry, to acquire its fullest development, it is sufficient if it be not impeded by the government; for then, private interest, which in these matters possesses the surest instinct, will guide each to his own advantage, and the general good will naturally result. It is true, that commercial treaties are not always conceived in the way most conformable to the wishes of the people, for in absolute monarchies, the personal advantage of the sovereign, or his political calculations, often induce him to regard commerce as a very secondary consideration; but such proceedings are very justly regarded as a bar against commerce. The existing treaties, then, between the country under examination and other countries, particularly the traveller's own, are well worthy of his attention in regard to their advantages or disadvantages to commerce.

Is the system of taxation, which immediately affects commerce, conceived in a way to press as little as possible upon articles of necessity, which, by encouraging their consumption, increases their production, or does the reverse of this obtain?

Are the laws and regulations of commerce generally

framed with a view to the public good, and well calculated to encourage commercial enterprise, or are the interests of commerce neglected in favour of other branches of industry, and which? Do the advantages or disadvantages bear upon any particular branch of commerce; and in this case, on which, or on all in general? Much of this kind of information may be gleaned from observing the activity of commerce in general, or of particular branches of it, or from the well-founded complaints of those whose interests are neglected.

To these observations we may add,—what is the proportion of the merchants to the other classes of the population; in what kind of estimation are they held; what privileges do they enjoy; are they generally rich; may they aspire to any situation in the state; do they intermarry with the nobility of the land; do they labour under any particular disabilities? Do many foreign merchants settle in the country? Are the merchants divided into classes; do they pay any thing for the right to traffic; do the nobility of the country take any share in commercial speculations? Are there any commercial schools? For the details of this latter, see EDUCATION.

What are the principal commercial companies of the country, what do they deal in, and with what countries?

Are there any fairs for inland traffic; of what kind are they, where and when held, and for what particular purpose, how attended, and what is the amount of business done, &c., &c.?

DIVISION V.

PARTICULAR INSTITUTIONS AND ESTABLISHMENTS.

SECTION I.

RELIGIOUS INSTITUTIONS.

This object may be divided into three parts, the first comprising the faith or belief; the form of worship and its ceremonies; the festivals of the Church; the ceremonies observed at births, baptisms, circumcision, betrothings, marriages, funerals, observances in honour of the dead, &c.; the second, everything regarding the clergy and priesthood; and the third, the examination of particular establishments, as churches, temples, monasteries, convents, burial-places, &c.

The observations to be made on the latter objects will be found under the article on CITIES.

Every thing regarding the first division of our subject, as far as it concerns the Greek and Roman Catholic religions, Protestant sects, Mahomedanism and Judaism, is so generally known, that little more need be said, when any of these is the religion of the country, than merely to state the fact; unless, indeed, there may have sprung up some particular new or little known sect, in which case, observe whether the innovation relates to the faith, the worship, the clergy, or the religious establishments. It may also be remarked, that in many particulars the same religion is much modified by circumstances in different places, and that though nominally the same it is sometimes hardly to be recognised: this circumstance and the nature of the modifications, with their

cause, are well worthy the attentive observation of the traveller.

As regards religions less known, the following observations should be made:—

Do the people believe or not in the existence of a Supreme Being; and, in the first case, do they regard him as good or evil? Do they believe that there is one Being supreme, or do they acknowledge the simultaneous existence of two divinities, one good, the other evil; and, if so, do they attribute equal power to each, or a superiority to one over the other, and which? Do they believe in other inferior divinities; if so, what is their number and their respective attributes? Is the religion Pantheistic? Do the people believe in the immortality of the soul, and what ideas have they of a future state of retribution? Are they fatalists, or do they believe in free will? What do they hold necessary to be done in this life, to receive happiness in the next? What is the nature of the rewards and punishments they expect in the life to come?

Together with the religious belief of a people we may consider their superstitions; for although the one is often independent of the other, they have frequently a very close connexion: indeed some religions are founded entirely on superstitious notions, and every religion has at some period or other of its history, consecrated superstitious fears and observances. When the religion is of that pure and enlightened nature that superstitious notions, far from being encouraged, are reprobated, still we find them laying strong hold on the minds of otherwise well-informed men. The mode of life has a great influence in this respect: thus we find, in general, that sailors of every country are among the most superstitious of men, a failing from which even their better educated officers are not wholly exempt. Generally speaking, however, the greater the ignorance, the greater the proneness to superstition. As the errors of a people have a decided influence over their conduct on many occasions, it is essential, whenever a people are to be described, to detail their prevailing superstitions, and to trace them, if possible, to their source, and follow them out in their effects.

After the religious belief and superstition of the people, the next subject of observation is their mode of worship, which is either simple, as when confined to public prayer, thanksgiving, and praise, or it is ceremonious; and the ceremonies may be either particular observances for the sake

merely of decency and order, or symbolical, or propitiatory, &c.

What is prescribed by the religion regarding prayers, ablutions, offerings, processions, &c.? What is the rank and quality of the persons who officiate at the altar, in the temples, &c., their costume on different occasions, their functions, &c.? Are the prayers and ceremonies accompanied by music, and of what kind; is incense burned and offerings made, and of what kind; is every one allowed to be present at the ceremonies, or are any excluded at all times, or on particular occasions; is it age, sex, rank, or occupation, that excludes? What are the most remarkable festivals; at what time of the year are they celebrated, and on what occasions; what is the origin of them, and for what purpose instituted? Is it deemed essential to observe strictly every thing ordered regarding the worship and religious ceremonies? What ceremonies are observed at the birth of an infant, are they the same for a boy and a girl, and, if not, what is the difference; is any ceremony of the nature of baptism or circumcision, &c., practised, and what is it; at what age is such ceremony performed? What are the religious ceremonies observed at betrothings and marriages; is there any difference, and what, in this respect, as regards the rank and station of the parties; at what age do they marry; are there any regulations, and what, regarding the consanguinity of the parties to be married? Is polygamy allowed, and to what extent? Does the religion of the country tolerate concubinage; the plurality of husbands, &c.? What is done with the dead; are they burned, buried, or embalmed, &c.; what ceremonies take place at the death and burial of persons in different stations; are any human beings or living animals sacrificed on the occasion? Are there any anniversary ceremonies in honour of the dead, and what are they; is it customary to erect monuments to the dead, and of what kind; what does the law or custom ordain regarding mourning, &c.

Does the priesthood form a class apart; or if not, from what order of the people are the priests taken, and by whom are they appointed? Who is the head of the church; what is the sacerdotal hierarchy; what are the titles of the different orders of priests; are these distinguished from the laity by any particular mark or by their costume, on all occasions, or only while in the exercise of their functions; what is the authority of the different orders of the priesthood; are the

priests excluded from exercising any other functions than those of religion, or are there some which they may exercise, and what are they; in what does their revenue consist, how, and by whom is it paid; what is their influence as a body in the nation; what is their conduct in general, and the degree of veneration and respect which they command? To what jurisdiction are the priests subject, and how are they punished for crimes or misconduct; or are they considered sacred and above the law; do they themselves hold any courts ecclesiastical, or criminal, or civil; what rule do they follow in their decisions; how are the trials conducted? Have they any written laws on the subject of religion; have they any secret or symbolical writing unknown to the people generally; are the priests, as a body, better informed than the rest of the people, or is the reverse the case? Are the priests distributed throughout the country so that all may have easy access to their ministry; do they live alone, or assembled in great numbers in or near the temples; may they marry; is there any thing in particular from which they must refrain; do they make vows; and, if so, what is the nature of their engagements, &c.?

In a word, every thing touching the religious institutions of a people should be observed, and their effects upon the moral habits and manners of the people examined with attention.

In countries where there are different religions, which predominates, and in what proportion are the others? Is there a religion of the state; is this merely nominal, or does it enjoy greater protection and privileges than the other religions, and in what do these privileges principally consist; or are all religions equally favoured? Is any contribution levied upon persons not of the religion of the state, for its support, is this contribution so great as to be burthensome, in what way is it fixed and collected? Is the religion of the state tolerant or persecuting? Does religious controversy run high, and does it ever lead to great disorders and loss of life? What difference is observable in the moral habits and conduct, the industry, &c., of those professing different religious persuasions?

To what degree is religion made a political instrument of the government, or is there a struggle between the chief temporal and ecclesiastical authorities?

What may be the amount of church property in the country? In Catholic countries it will be well to enumerate the

several religious orders, men and women, the number of individuals in each; the wealth of these bodies, their influence and conduct, and the disadvantages resulting from the existence of so many drones.

What is the general history of the national religion and its revolutions, with the effects they have had upon the prosperity of the country? By what means and at what times have other religions been introduced, &c.?

SECTION II.

GOVERNMENT.

The government of a country is either Monarchical, Aristocratical, Democratical, or Mixed, and each of these forms may be differently modified.

It may be well to remark, not only that the nature of the government of most countries is known, but that the relations of travellers and the descriptions they give of the different forms of government, in the different countries they visit, can have little or no influence in effecting any changes in this respect, however desirable they may be. Nevertheless, when the observations of an intelligent individual bear upon the immediate or distant causes of national prosperity or decline, they awaken attention, invite reflection, and have been sometimes known to provoke the suppression of an abuse or the adoption of beneficial measures. The form of government, therefore, and the mode of administration are deserving of every attention, less perhaps as considered in themselves, as in the relation they bear to the character of the people, to their manners, to the degree of civilization, the climate, religion, &c., for it is by the harmonious combination of these elements that national prosperity is established and preserved. To understand, however, the combined action of different institutions, each must first be considered in itself, and hence the necessity of examining and

describing in detail the government of the country visited; and this is so much the more necessary, because, if, while the form of government remains thus unaltered, the other elements of the social state undergo alterations, the relations are no longer the same; so that, though the positive form of government which prevails in any particular country may be known, its relative influence is changed; or it may be, that though the name and kind of government remain the same, it has undergone such modification as greatly to have altered its nature. Observe, then, what is the form of government, if it be a—

MONARCHY.—Observe whether the sovereignty be elective or hereditary: if it be elective, what is the number of the elective body, and of whom is it composed? What do the laws and customs ordain regarding the rank and fortune of the electors, and the form of election. What are the qualifications required of the sovereign? The election once made, do the people submit at once to the choice, or is the election much contested before hand and opposed afterwards? What alterations have been made in the mode of election, or in the qualifications required of the sovereign in late times; what has given rise to these changes, and what are the results?

If the sovereignty be hereditary, is it equally so in the female as in the male line; that is to say, may females reign, or are they excluded from the throne? In some countries the males are excluded. In default of direct descendants, is it the brothers or sisters, nephews or nieces, that succeed? in a word, what is the order of succession? At what age may the heir take upon himself the sovereign authority; does this depend upon the will of the deceased sovereign, or is it regulated by a fundamental law of the constitution? In some countries the sovereign may appoint a successor to the throne in exclusion of every branch of his own family. In the event of the heir being too young, who, by right, exercises the regency; or is a regency appointed for the occasion? Are the full powers of royalty vested in such regency, or are certain regal functions excluded, and what are these? Have any remarkable changes been made in the law of succession; if so, of what kind, and what have been the cause and the consequence?

Is the sovereignty despotic, or is the power of the monarch limited; and if so, is it by law, by custom, or by the sense of the people and the spirit of the nation? Thus the sove-

reigns of Russia have, by law, a power as despotic as that exercised by Ivan the Cruel, but the sense of the people in the present day acts as a preventive to such abusive exercise of power as was formerly endured. Is the sovereign the head of the church, and is the dignity only nominal, or does the monarch exercise the functions of that office? What Senates or Councils are there to assist the monarch in his government; from among whom does the sovereign choose them; when once appointed, are they permitted to act with independence, or are they merely the tools of the monarch, and subject to dismissal according to his will and caprice? How are such Senates or Councils constituted; what are their functions and prerogatives?

What ceremonies are observed on coming to the throne; is the sovereign crowned; and if so, what are the solemnities practised on the occasion? What are the titles of the sovereign, the marks of distinction he usually wears, and his costume on great occasions? How does he go abroad; is he escorted by troops; and if so, is it merely as a mark of honour, or deemed necessary for his personal safety? What are his revenues, his rights, his prerogatives, and his authority? and, in countries where heraldry prevails, what are his arms and livery? In certain countries particular colours belong exclusively to royalty, as did purple with the Romans, and as yellow now does to some of the sovereigns of India. What ensigns, standards, or other similar objects belong exclusively to the monarch, and are carried before him, placed before his tent, or on his castle, &c.?

On coming to the throne, does the sovereign engage upon oath to watch over the happiness of his people, to maintain inviolate the laws and institutions of the country? Obtain, if possible, a copy of the oath or promise; What is the consequence of a violation or breach of this oath? On the accession of a new sovereign, do the subjects take an oath of allegiance; if so, how is it worded; or is there any other kind of contract tacit or declared between the people and their monarch? What does the law ordain in case a subject refuse to take the oath of allegiance?

What are the titles, privileges, and power, of members of the royal family; how are they distinguished, and what degree of consideration do they enjoy; how is the education of the young princes, and chiefly of the heir to the sovereignty, conducted?

When there is in the country a class of nobles, what are

the several titles and dignities, in order, from the highest downwards? When were these several titles created, by whom, and on what occasions? What are the privileges and power of each class of nobles; of how many individuals is each class composed, and what is the total number of the nobility? Is nobility merely personal, and dependent on creation by the monarch, or is it hereditary, or are these of both kinds? When hereditary, does the title descend to all the male children, or only to the eldest? In marriages among the nobility, if the wife be of a higher rank than the husband, does she retain her own, or does she take the lower rank of her husband? Are marriages between nobles and commoners usual; or are they prohibited by law, or disapproved of by public opinion? Are there, as in England, titles of courtesy for the younger sons of the nobility, and what are these titles? May a noble be deprived of his nobility; if so, in what case, and by whom; does his family suffer the degradation along with him; is such punishment accompanied by confiscation of property?

May the rank and title of nobility be purchased by any one able to pay the price demanded, or is the faculty of purchase confined to some particular class or qualification; what is the price paid for the different titles? Have the nobility any particular influence; if so, what is its nature and extent; how do the nobles stand with regard to the sovereign and to the inferior orders of the nation? Is their influence derived from the laws, from their wealth, from the posts they hold, or from public opinion? Are the nobility generally a selfish, haughty, and overbearing body, tenacious of their privileges, and averse from mingling with the lower orders; or are they, on the contrary, remarkable for liberality, amenity, and patriotic spirit; do they patronise the arts and sciences generally, or any in particular; are they in general a well-informed body; is it common for them to devote themselves to useful learning; have any rendered themselves remarkable in this way; are the nobility in general loved and esteemed by the inferior orders, or the reverse?

Are there any orders of knighthood and what are they; by whom, when, and on what occasions were they created; is the number of knights limited or unlimited; what kind of services are rewarded with orders of knighthood, and may these orders be conferred on the deserving of every rank; are they conferred only when there is real merit, or are they given through favour and intrigue; what are the badges of

the several orders; their authority, privileges, and revenue, and their order of precedence? Are there any orders or badges of distinction for females, and what? What is the actual number of knights of the different orders, and what ceremonies are observed on their creation; by whom is the dignity now conferred?

Are there, moreover, any other marks of distinction, as gold chains, medals, feathers, arms, &c., given in recompense of different kinds of services, but unaccompanied by titles; what are the kinds of service so rewarded; by whom are these distinctions conferred, &c.?

ARISTOCRACY.—In an aristocracy what are the rank, titles, and power of the persons exercising the supreme authority; what is their number and is it limited or unlimited; do the members of the supreme council sit there by hereditary right or by election; in the first case, if the number be limited, how are vacancies filled up when there is no heir; in the second case, who are the electors; what are the qualifications required of the elected and the electors, and how is the election carried on; do the persons composing the supreme council keep their seats and exercise their functions for life or for a limited period, and how long; may a member of the supreme council be deprived of his situation and for what offences; in whom resides the power of removing or expelling a member from the supreme council? It must be remembered that in an aristocratic government the nobility are every thing and the people nothing; the right of election, therefore, to the supreme council and to other situations in the state, is generally confined exclusively to the aristocratic body; they also exercise the whole legislative and executive powers; if, however, the people are rich, they may exercise a very extensive influence on public affairs, even under an oligarchy; this circumstance, therefore, is worthy of notice.

Besides the supreme council, what other councils are there; how are they composed and what is their power? What are the rank and titles of the nobility, and their number; what is the number and authority of the magistrates and how are they appointed? Are the people happy under their government, or do they desire a change and are they likely to effect it, &c.?

DEMOCRACY.—In a republic how are the powers divided: what are the bodies or who are the persons, to whom the several powers are delegated; what are the denomina-

tions and the particular organization of the different bodies; what power have they; what are the emoluments and distinctions of the individuals who compose them and the duration of their authority; how are the elections carried on, and what in all cases are the qualifications required of the electors and of the elected? What are the classes and orders into which the citizens are divided; the numbers of these several classes, their titles, rights, privileges, and duties, and the degree of consideration they respectively enjoy; of what order of citizens are the several legislative and executive bodies composed; has each class of the community its representatives, or is the representation based upon numbers without reference to particular calling; in either case what is the proportion of the representatives to the represented; for what length of time are the representatives appointed; in what body resides the power of levying taxes, declaring war and making peace, of enacting new laws or abrogating old ones? What remarkable changes have taken place in the form of government of the republic; what have been the causes of these changes and their effects?

What are the forms observed in the different assemblies, councils, chambers, &c., for the transaction of business; and what is there particularly advantageous or the reverse in these forms? At what periods are the several assemblies convened, by whom are they called, how long do their sessions last, and how are the affairs conducted during their vacation?

What are the fundamental laws of the state and their origin; what is prescribed by the constitution regarding the abolition, the reform or innovation in general, in the form of the government itself, in legislation, in the civil, ecclesiastical, military, and other establishments; by whose authority, by whose votes, from what motives, or from what combination of circumstances, may such change be effected? What is the legal or tolerated power of the chief magistrate; have the constituents the power, at any time, of recalling their representative and sending another, if dissatisfied with the first; are the duties of a representative gratuitous, or are they paid; and if so, at what rate?

How are the different branches of the administration distributed, and are they conducted in a manner to give satisfaction?

Finally, is the form of government, as a whole, such as is

best suited to the state and wants of the country ; and, if not, why?

MIXED GOVERNMENT.—In a mixed government, how are the parliaments or assemblies constituted ; what are their powers ; what are the powers and prerogatives of the people, of the nobles, and of the Sovereign? How are the several powers balanced, so that neither may predominate? Have circumstances at all deranged the equilibrium originally existing ; and, if so, on which side is the greater power and influence, and what is, or is likely to be, the result of such a state of things?

GENERAL REMARKS.—There is an endless variety of questions which may be asked regarding the details of government in every country ; many will be found interspersed throughout the present work, under different heads ; and for those which may have escaped us, or which it would be impossible to insert, without swelling our volume beyond due bounds, we must rely on the intelligence of the observer. There are, however, a few important questions which apply alike to every form of government, such, for instance, are the following :—

Are the different situations in the gift of the government, disposed of according to real merit and proved fitness, or does a prejudicial system of favouritism and patronage prevail ; or may places be bought and sold? Are real and important services rendered to the state adequately requited? Are the poor but deserving servants of the public provided for when no longer able to attend to their duties? Is the government really wise and paternal ; are its efforts directed more exclusively to the happiness of the community, or to a vain-glorious standing among other nations?

In a word, observe the form of government, as a whole, and its bearing upon the actual state of the country. Observe its details as mutually relative to each other and to the system ; whether the basis on which the system is built, is solid and likely to be durable, or if it contain within itself, or from want of assimilation with the several habits, manners, and state of the people, the seeds of speedy dissolution.

If several people or nations are under the same government, observe by what relations they are mutually bound and kept together ; what branches of the general government are alike for all, and in what particulars are the

different people allowed the exercise of their own forms of government; what are the causes and consequences of such dissimilitude in the administration of different parts of the empire, &c.?

SECTION III.

LEGISLATION.

Montesquieu, whose single name is an authority of more weight than the thousand-and-one volumes of other authors, written often in a spirit of prejudice and partiality, defines laws, in the fullest acceptation of the word, "The necessary relations resulting from the nature of things." Man in his savage state and man in society are equally subjected to laws; in the former case, to those called the laws of nature; in the latter, to human laws. Natural laws, according to the same author, are four in number, viz.—1st. those which induce man to live at peace with his fellows, from a sentiment of fear founded on the consciousness of his individual weakness; 2nd. the sense of his wants, which forces him to seek the means of subsistence; 3rd. the irresistible attraction of the sexes, which urges him to the propagation of his species; and 4th. the natural development of his faculties and his intelligence, which leads him to seek society, and to find pleasure in sociability.

As soon as a society is formed, new relations give rise to conventions, which are sometimes sufficient for the maintenance of peace and tranquillity, particularly if the society be limited in its numbers; but more generally the acts of aggression and violence, on the part of the stronger, induce a state of civil warfare, which gives rise to positive laws for the protection and well-being of the community, and to the establishment of some form of government for the proper execution of these laws.

We have already spoken of the different forms of government, we are now to confine ourselves to the subject of

legislation. "The laws should be appropriated to the nation and conformable to the established principles of government; whether they themselves form it, as do political laws; or whether they maintain it, as do civil laws."

They must be in harmony with the physical state of the country; with its climate, whether frigid, torrid, or temperate; with the quality of the soil; the situation of the country and its extent; the mode of living of the people, whether as agriculturists, hunters, or pastors; they must bear a relation to the degree of liberty which the constitution admits; with the religion of the people, their inclinations, their riches, their numbers, their commerce, their morals, and their manners: finally, the laws have relations among themselves; they also bear relation to their origin, to the object of the legislator, and to the order of things on which they are founded. Under all these relations, bearings, and points of view, they should be observed.

From the examination of all these analogies, has resulted that immortal work, the "Spirit of Laws; which, whosoever would fit himself adequately to observe the legislative system of any country, should prepare himself by studying with diligence.

We must in this place confine ourselves to pointing out such observations as every one is capable of making, and the details of which are most important, whenever we would describe the social state of a people.

We shall divide the subject as follows:—

1. Legislative power.
2. Legislative body.
3. Laws.
4. Executive power.
5. Executive body.

LEGISLATIVE POWER.—Legislative power resides by natural right in every individual; but the very various and often opposite interests of men, the particular occupations of each, and the great ignorance of the mass, are circumstances which, with many others, render very inconvenient even in small states, and quite impracticable in large ones, the popular exercise of legislative power: but that which the people cannot do of themselves, they may appoint others to perform. These delegates are presumed to act in accordance with the will, and with a special

view to the interests of at least the majority of those whom they represent ; and in this way the people are said to impose themselves the laws by which they are governed.

The number of representatives in no way alters the proposition. When the people in mass, or a great number of representatives who may be recalled at the pleasure of those who appoint them, exercise the legislative power, such a state of things is called a republic ; when the nation has placed the legislative power in the hands of a few, whom they suppose able and patriotic, it is an Oligarchy ; and when the whole of the nation, in a moment of gratitude for eminent services rendered to the state by an individual, of enthusiasm for his virtues, of devotion to his person, of confidence in his love of justice, place the whole legislative power in his hands, it is an absolute government : but the before announced proposition remains the same in theory, as the sovereignty of right resides in the people. The sovereign, the nobility and the representatives merely exercise a power which was originally delegated by the nation, and has been since continued.

Be it observed, however ; that though true in principle, the proposition is false in fact ; the people having in every case, save that of a republic, abandoned their right of legislative power ; and even the deputies in a republic, as well as the sovereign in a monarchy, may and do often, abuse their power ; or without intentional abuse, make laws contrary to the desire and the interests of a great part of the nation.

If, however, it may be desirable that a nation in a high state of civilization should itself exercise the legislative power, it is certain that when a nation is but littlė advanced, it is for its advantage that it be prevented from the exercise of a right which it does not understand and would therefore abuse.

In a general point of view, therefore, the traveller should observe by whom the legislative power is exercised ; is it absolute or moderated, and how ; what circumstances have given rise to the present order of things in this respect, what is its date ; what are its advantages and disadvantages in the present state of things, and its probable consequence to the future welfare of the state ?

LEGISLATIVE BODY.—The assemblage of persons exercising the power of making laws is called the *legislative body*. In a country where there are several orders, as the people, the middling classes, (*tiers état*) the nobility, the

clergy, agriculturalists, manufacturers, and merchants, it is essential that the legislative body be formed from all these classes, in order that the laws may be equal for all, and based upon the common interest.

Observe, then, how the legislative body is organized; observe whether the different interests have their respective representatives, or if any are excluded, and which, and wherefore.

Can the representatives of the people take the initiative whenever it is their interest so to do, or has the sovereign alone the right of proposing the subjects to be considered by the legislative body? In the latter case what steps are taken to induce the monarch to propose the discussion of a new law, or the alteration or abrogation of an old law? Does the sovereign ever refuse the demands of his people in such case? Is the monarch bound to confirm the laws once enacted by the legislative body, or has he a *veto*, and does he ever exercise this prerogative?

When the several classes of the state have their representatives in the legislative assembly, are the functions of these representatives exclusively confined to guarding the particular interests of the class they represent, or may all participate equally in general discussions, and contribute to the framing of laws on all subjects, watching particularly the interests of their constituents, but seeing at the same time, that no laws shall be made to favour any particular interest at the expense of others. Observe, then, how the affairs of the legislative body are conducted, the number of persons of whom it is composed, &c., (see *Democracy*, Sect. GOVERNMENT.)

In an absolute monarchy, though the will of the sovereign is the sole law of the state, the monarch generally calls a senate or council for the specious purpose of enlightening him, but, in reality, to serve as a mark to cloak the extent of his arbitrary power, and to give to his supreme will the appearance of the public good.

In governments where there are councils of this nature, they should be noticed with everything regarding them. What generally determines the sovereign in the choice of members of this legislative council; from what order of the state they are taken; their number, their power, their prerogatives, &c.? In a word, of whatever nature the legislative body in a country may be, its organization, attributions, powers, &c., should be ascertained, and the influence of the system on the general prosperity of the country.

LAWS are derived from the climate and the manners and morals of the nation; but these morals themselves are greatly dependent upon the laws; for in this, all is action and re-action.

Men, says Montesquieu, are governed by different kinds of laws; by natural law; by divine law, which is religion; by ecclesiastical law, called canonical, which regards the rules of the church; by the law of nations, which may be considered as the civil law of the universe, in as much as each separate people is, as it were, a citizen of it; by universal political law, whose object is that human wisdom which has founded all societies; by particular political law, which regulates each separate society; by the law of conquest, founded on the fact that one nation has willed, has been enabled, and necessitated to commit violence on another nation; by the civil law of each society, by which a citizen may defend his property and his life against any other citizen; and lastly, by domestic law, which results from the division of the society into different families, each of which requires a government of its own.

There are, therefore, different orders of laws; and the perfection of human reason is shown in discovering to which of these orders in particular the objects belong, on which enactments are to be made, so that there may be no confusion in the principles by which men should be governed.

This last paragraph contains the exposition of what should be the general result of the observations to be made on the legislative system of a country; but we must enter into a little more detail. We have seen in the beginning of this article what the laws of nature are, it may, therefore, easily be ascertained how far these are seconded or counteracted by human laws.

As for divine law, the way in which it is regarded and inculcated, will be gleaned from the religious code of the nation. The observations to be made on this subject, will, as well as what regards *Canon Law*, be found under the article Religious Institutions.

The laws of nations and the laws regarding the relations existing between different people, are founded on the principle that all nations, while at peace, should do each other all the good they can, and in time of war, the least possible ill, without violation of their own best interests. The object of war is victory, that of victory conquest, and of conquest possession or preservation. From this and the preceding

principle, are derived all those laws which are called the rights of nations. See FOREIGN RELATIONS.

As for particular political laws or rights, they are formed from the combination of particular influences, and their object is the establishment and maintenance of a particular form of government; which, of course, varies as the elements on which they are founded vary in nature or intensity of action. See the article GOVERNMENT.

Civil right or civil law is founded on a combination of individual wills; whence, it follows, that there can be no civil rights or laws, properly so called, under an absolute government. The principal objects of civil laws are property, and individual security against every species of violence and injustice; that is to say,—civil laws are enacted for the security of the life, liberty, honour and fortune of every individual of the community, against every kind of violence and fraud.

Now, as laws cannot repress injustice and crime, but by the infliction of penalties, a special code, under the name of criminal laws, or *Penal Code*, is formed for the punishment of offences; while the collection of laws relating especially to property and the modes of acquiring it by prescription, transfer, or succession, is called the *Civil Code*. The Civil Code also regulates, together with the *Canon Law*, everything regarding marriages, legitimation of children, &c. In a word, the civil law takes cognisance, as we have said, of the reciprocal relation of individuals; while the *Political Code* bears upon the relations which exist between the governing and the governed, and regulates the legislative institutions of the country.

With regard to civil laws the traveller should observe; how far they are truly national, that is to say, conformable to the manners and morals, the state of civilization, and generally to everything which constitutes the social system that prevails. Do they, moreover, accord with the climate and with the laws of nature? Do they fully answer the ends proposed by their enactment or not; and, if not, in what are they defective? It cannot be expected that a mere sojourner, still less that a passing traveller, should examine all the laws of a country in detail; it will suffice if he acquire a general notion of the several codes, and the principles on which they are formed. He may observe their effects in a thousand instances of daily occurrence, and should note whatever may strike him as most

remarkable. He should particularly notice whether the penal laws are themselves cruel, and are rigorously enforced; or whether the law, or the practice, be characterized by a spirit of humanity. The penal code of a people, if it be not too old, gives a pretty correct idea of public and private morals.

Some countries, however, have no national code ; in such a case, what are the Edicts, Ordinances, or Decrees, by which public and private affairs are regulated, and according to which, causes of all kinds are judged? What are the consequences resulting from inconsistency in the different branches of legislation, such as frequent contradictions, facilities for chicanery, arbitrary sentences, corruption of judges, &c.?

Observe whether the same system of laws be followed in all the tribunals of the country, or if, in certain provinces and towns, there are particular and local laws ; if they are written laws or traditionary customs and usages ; in what respects the laws differ in different parts of the country ; if the places enjoying the privilege of particular laws are multiplied in the country ; what gave rise to such privileges, whence they date, and what effect this variety of laws has on the general affairs of the nation. As for the codes of laws belonging to certain corporate bodies, professions, &c. see RELIGIOUS INSTITUTIONS, MILITARY INSTITUTIONS, &c.

On the subject of domestic laws, observe what powers are given by the laws of the country to heads of families over their wives, children, and domestics. Are these powers in harmony of principle with the general laws of the country or otherwise, and what, in either case, is the consequence on the happiness of families, and on the public prosperity?

EXECUTIVE POWER.—Having spoken of laws and legislative bodies, we shall now say a word of the execution of the laws ; for it is evident that the best laws are of little avail for the prosperity of a people, if they be not properly executed.

Montesquieu very properly observes that the executive should be in the hands of a monarch, because that branch of government, which always requires promptitude, is much better administrated by one than by many ; whereas what relates to legislative power, is often better regulated by several than by one.

In a free state the executive has no right to stop the

enterprises of the legislative ; in an absolute monarchy the case is otherwise. In no case should the executive power be impeded by the legislative ; but this latter should reserve to itself the right of examining into the manner in which the laws it has framed are executed. Nevertheless, the person of the Sovereign should always be inviolable, and the responsibility of the executive power should fall on the ministers or legal advisers of the crown.

The executive power, says Montesquieu, again, should share in the legislation by its faculty of preventing ; without which it would soon be deprived of its prerogatives. This maxim is just in principle, so long as it is confined to the mere defence of Royal Prerogative, and in point of fact this right of preventing is rarely exercised by a sovereign, as that which is demanded by the majority of the nation must be for its advantage, and in such case, nothing but obstinacy, or the worst of passions, could induce the monarch to exercise his preventive prerogative. Further, this power, if frequently exercised, would annul all other powers, and of a free or constitutional government nothing but the name would be left.

These few words must suffice to point out the kind of observations to be made on the executive power in a state. By whom and in what manner is it exercised ; what are the guarantees of its independence, on the one hand, and the safeguards against its abuse on the other ? What is the result, on the national prosperity, of what the fundamental laws of the country have established regarding the executive power ?

EXECUTIVE BODY.—By executive body, we mean collectively all those persons whose particular functions are to enforce the laws, by executing what they prescribe for the maintenance of the public institutions, and for the individual and general safety. To it belong all magistrates of every denomination, from the sovereign down to the petty burgomaster ; all judges and expounders of the law, from the chief justice down to the common notary ; and all persons employed in judicial administration down to the bailiff and the executioner.

We thus separate the legislative from the executive, though in all countries despotically governed, and not unfrequently in those which have representative forms of government, the same individuals exercise the functions of legislators, of judges, and of executors of the law. In every

proper system of administrative justice, these three functions should be kept separate; but as it is impossible for any human laws to foresee and provide for every individual case and particular circumstance, a certain latitude must unavoidably be left to the judge; who, in such cases, must act, not according to the *letter*, but, in conformity with the *spirit* of the law. This latitude, however, must be limited, in order not to open the door to arbitrary judgments and unjust sentences.

It may appear to many, that the functions of a judge, as the name seems to imply, is to judge and not to execute; but to judge is, in fact, to execute that part of the law which declares that an accused person shall be judged; for this reason it is that we have included judges in the executive body.

It has been found necessary in civilized countries to establish a certain order of procedure towards persons accused of crimes and misdemeanors: these forms require the co-operation of a greater or less number of persons according to circumstances. This assembly of persons is called a *Court of Justice*. In some countries, the same tribunal takes cognisance of affairs of different kinds, sometimes at the same sitting, and sometimes at particular and stated times. It also happens that the same tribunal judges, on some occasions according to law, and on others according to equity, as is the case with the Exchequer Court of England; but more generally there are distinct tribunals for the different kinds of affairs, as, for instance, Tribunal of Commerce, Ecclesiastical Courts, Military Tribunals or Courts Martial, Police Courts, Criminal Courts, Courts of Appeal, &c. Their names sufficiently indicate their nature.

The traveller should therefore, as far as his time and opportunities will permit, make himself acquainted with the various tribunals of the countries he visits; their number, their distribution, their organization, the extent of their several powers, and the co-relation of the whole. Do they continually sit, or only at stated intervals; in the latter case, when and for how long do they sit?

The mode of proceeding at the several courts should be noted, with every thing particularly worthy of remark. Is the number of lawyers calculated and determined according to a wise division of their particular duties; have they a salary and fixed emoluments, and to what sum may these amount? If their salaries are too small, or are not fixed, does not their great numbers and the defective system of

remuneration, form a class of men who profane justice and disturb the public tranquillity?

What measures are taken to ensure the integrity of the judges and to prevent all kinds of prevarication and unfair dealing on the part of lawyers? How are such offences punished?

In countries where juries exist, the functions of the judges are confined to the superintendence of the forms of procedure, to enlightening the jury on points of law, and to pronouncing sentence according to the law, after the verdict of the jury. On such a system, it is difficult for a judge to act in an arbitrary manner.

What preliminary studies are required of persons intended for the law and magistracy? Are all kinds of trials, particularly in criminal cases, carried on publicly or privately, or are there any cases, which, though the trials be generally public, are carried on privately; as crimes against the state, or offences of such a nature that they could not be publicly tried without offending public morals? What kind of proofs are required in order to establish the guilt of the accused in different cases, and what means of defence are allowed them?

In the mode of apprehending a suspected person, of his detention and treatment until he be condemned or acquitted, are his individual rights respected as much as the public safety is guaranteed by his arrest? if not, observe to what degree the arrest and detention are arbitrary, harsh, and ignominious, and if, in the prison, the merely suspected are confounded with convicted criminals who are already undergoing a part of their punishment. Does the detention of one suspected, last only as long as is absolutely necessary for bringing on and going through with his trial, in order that the innocent (for the suspected may prove to be so), may not be unjustly kept in painful suspense, and deprived of their liberty, or, in the case of guilt, that the effect of prompt retribution may not be lost by useless delay?

Is the arrested individual, when his innocence is proved, indemnified after his acquittal, for the injury he has sustained, and completely reinstated in his honour and his fortune?

As for what regards prisons, see the article Cities. Are the provincial prisons on the same footing with those of the capital, and to what kind of inspection are they subjected?

Is the execution of the sentences of the law rendered sufficiently public and solemn to produce a beneficial effect on the multitude, or the reverse; as is but too frequently the case? Are executions performed, whenever it is possible, at the place where the crime was committed?

Besides the exercise of justice by authority of government, are there any particular individuals, classes, or bodies, having the privilege of holding courts of justice, with power of life and death? Who are the so privileged, and what is the effect of such a state of things? Are any persons or places, who and what, privileged to grant asylum, and frustrate, by that means, the ends of justice?

To what extent may the tribunals be influenced by supreme authority, or bribed by individuals? What steps are taken to discover errors and abuses, and to reform them, together with obsolete or injurious customs?

Are the laws the same for strangers as for natives; if not, in what does the difference consist; are the conquered allowed to preserve their own laws, or are they forced to adopt those of the conquerors; in the former case, in what does the difference of the two codes consist, and what is observed to be the result of these various legislations in retarding the amalgamation of the conquered with the conquerors?

Is there any secret police or system of *espionage*, and what is its result on the public mind and morals?

What crimes are the most frequent, and to what cause may they be attributed; to climate, to the system of education, or to the government individually, or to all these united? What means might be adopted to remedy these moral evils, and what have hitherto been the obstacles to their adoption?

To all these and many other observations of a similar nature, should be added, the annual expense, particular and total, of the whole justiciary organization of the state; by whom and how it is defrayed, by whom the judges and lawyers are appointed, &c.

SECTION IV.

FINANCE.

TAXES.—As all revenue is derived infinitely from *Rent* or *Profits*, or *Salary*, so every tax must ultimately be paid by one or other of these sums, or by all of them together. The following four maxims of Adam Smith should always be borne in mind, whenever we would direct our attention to the system of taxation in a country:—

First Maxim.—The subjects of a state should contribute to the support of the government, each in proportion to his means; that is to say, in proportion to the revenue he enjoys under the protection of the state. The expenses of the government are with regard to the individuals composing a great nation, what the expenses of management are to the co-proprietors of an extensive domain, each of whom is obliged to contribute in proportion to the share he has in the property of such domain. The strict observation or the neglect of this maxim, constitutes what is called equality or inequality in the distribution of taxes. Every species of taxation which falls definitively on one only of the three kinds of revenue, is necessarily defective and unequal, in as much as it does not affect the other two.

Second Maxim.—The amount of taxation to be paid by each individual, must be determined and not arbitrary. The time of payment, the mode of payment, and the sum to be paid, must all be defined and rendered clear, not only to the contributor, but to every one else. When this is not the case, every one subjected to the payment of a tax, is placed more or less at the discretion of the collector, who may then either increase the amount of contribution from animosity towards the contributor, or extort money or presents by exciting the fear of being overcharged. The uncertainty of the taxation favours insolence, and tends to corrupt a class of men, generally odious to the people, even when they are neither insolent nor corrupt. The certain knowledge of what each has to pay is, in matters of taxation, a thing of such importance that even a considerable degree

of inequality in the tax itself, is nothing like so great an evil as the smallest degree of uncertainty.

Third Maxim.—Every tax should be collected at the time, and according to the mode presumed to be the most convenient for the contributor. A tax upon the rent of lands, or upon houses, should be made payable at the usual time when the rents are collected, for it is probable the contributor is then most able to pay. All taxes on consumable articles of luxury, are ultimately paid by the consumer, in a way very convenient to him; he pays by degrees as he purchases the articles, and being free to buy or not, it must be his own fault if ever he experiences any great inconvenience from such taxes.*

Fourth Maxim.—Every kind of taxation should be so arranged as to take as little money as possible out of the pockets of the people, beyond what is actually received into the treasury; and also the least possible time should elapse between the payment made by the contributors, and the deposit of the money in the public treasury.

The traveller will therefore note whether, in regulating the taxation, attention has been paid or not to these four fundamental maxims, or whether the system, being conformable to one or more of them, is not so to the rest, and which.

Let us, however, enter into a little more detail on this interesting subject.

Is there a land-tax, that is, a tax on the rent of lands; is such tax determined according to a fixed census, or does it follow all the variations to which the revenue of the land is liable, so as to rise or fall in proportion to the amelioration or neglect of its cultivation? In the former case, what kind of valuation was taken as a basis for fixing the tax, and in the latter case what proportion is established between the rent and its taxation. As the latter mode is

* Many persons, however, are of opinion, that excise dues are the very worst species of taxation, as having a direct tendency to create and maintain high prices. We cannot here go into the discussion of this extensive subject. Certain it is, as we have remarked in a former part of this work, that one effect of excise dues is to make the people pay twice as much in the shape of taxes, as is received into the treasury. But many persons prefer paying a greater sum in the long run, by imperceptible degrees, than a less sum upon the whole, if it be required in a large amount at one payment.

most injudicious, it is not generally followed: when the other system prevails, endeavour to ascertain, whether every necessary care has been taken that the distribution of the tax may be equitable and conformable to the maxims above quoted?

It may be remarked that a fixed tax, though perfectly well imposed in its origin, may become, in time, very unequal; therefore, wherever there exists such a tax, note should be made of the time when it was established; what was the proportion between the tax and the revenue, and what have been the variations in this proportion during a certain number of years. Is the actual proportion the same in all the provinces or different; and to what may the difference in the proportion generally as regards different epochs, or in different parts of the country at the same time, be attributed, and what are its effects?

What is the actual amount of the land tax, if it be fixed; and, if it follows the variations in the value of land, what was the original amount of the tax when first established, and the sum now paid into the treasury for the same land?

We may still further observe that, when the tax is invariable, if the prosperity of the country causes the rents to rise, the difference in the proportion between the revenue and the tax is in favour of the proprietor; and that, on the contrary, when the rents fall below what they were when the tax was first laid on the land, the difference is in favour of the treasury. In like manner an increase in the value of money, since the first establishment of a fixed tax, is a disadvantage for the proprietor, and a decrease in the value, a disadvantage for the treasury.

There are different ways of imposing a tax on land; sometimes it is according to the presumed value of the produce of the soil; sometimes according to the actual rents, the leases being registered. But as the proprietor and the farmers may combine to defraud the treasury, it is desirable to know what measures are adopted by the government to ensure the due payment of the tax. How is the tax paid; is it in money, in produce, by services wholly or in part?

When the tax is paid in produce, does the government take such produce at a fixed and invariable price, or according to the market price at the time of collection? Do the collectors take the produce on the spot, or are the contributors obliged to transport it to distant storehouses; and, in such case, is the expense for the transport deducted or not

from the amount of the tax? Is any deduction made in the land tax when the proprietor cultivates his land himself? Is there any difference, and what, in the tax levied on the lands of the clergy, and those of the lay population; those belonging to the nobility and the commons? Do the military and other servants of the state enjoy any immunity from the land tax? Upon what grounds have such distinctions been made and what is the result of them?

Do the crown lands pay any thing to the treasury? In cases where it is customary for the crown to grant the use of lands or domains for a certain time in recompense of services rendered to the state, are such lands charged or not with a tax; and if so, is such tax the same as that on other lands, or less, and in what proportion?

The tax upon land is very burthensome in some countries where, being proportioned to the produce of the soil, it has the disadvantage of being very irregular and unequal. A given quantity of the produce being according to circumstances equivalent to very different proportions of the rent or revenue. Many states have been, and in Asia still are, supported by a tax proportioned to the produce of the soil, and not to the revenue it brings to the proprietor. But, if we except China, perhaps there is hardly any country where such a mode of taxation does not produce the greatest inconvenience.

A house is a capital represented by the cost of its construction; it ought, therefore, to give a return equal, at least, to the interest of the money expended upon it, if the money were lent at the usual rate and on good security, with as much more as is necessary for keeping the house in constant repair; otherwise, it would fall into ruin and the proprietor lose his capital. But besides the house, the land on which it stands must be considered. If the proprietor of the house be not at the same time proprietor of the land, which is commonly the case, particularly in cities, the owner of the house must, in addition to the rent he derives from his house, receive a sum equivalent to the rent he pays for the land; and when he is proprietor of the land as well as of the building upon it, he should receive the rent for both house and land.

The rent of houses considered in themselves depends on their size, their magnificence, and the conveniences and accommodations they afford. The rent of the land on which houses are built or to be built, depends upon the situation, the extent, &c. Of two houses, in other respects equal, but dif-

ferently situated, the rents will be proportioned to the advantages of the situation. Hence the rents of houses depend partly on the advantages afforded by the houses themselves, and partly on their situation.

A tax upon houses is an unequal tax ; when paid by the tenant it falls partly on himself and partly on the owner of the soil. It is one of those taxes which falls indifferently on the three sources of revenue ; rent, profit, and salary.

When such a tax exists, ascertain how it is imposed ; is it in proportion to the revenue derived from the houses, or regulated by the cost of construction. Do houses, not inhabited, pay ? Who pays the tax, is it the proprietor or the tenant ? When a house is occupied by the proprietor, does he pay in proportion to the rent he would have received if he had let it, or otherwise, and how ? At what time is the tax collected ; what proportion does it bear to the rent, and what is the annual amount of the tax for the whole country ? Is the taxation uniform for all kinds of houses, those in the country as well as those in cities and towns, and for all times alike, or are there any exceptions, and if so, what is their nature and on what are they founded ? Sometimes it is not the house but the rent of the ground on which it is built that is taxed, in this case the tax falls wholly on the proprietor of the soil ; a mode which has the advantage of not increasing the rent of the houses, and consequently does not discourage building enterprise.

Houses are taxed in various ways in different countries ; in some according to the number of fires ; in others, the number of windows, &c. ; modes of taxation very burthensome on many accounts and very unequal, and which affect the poor more than the rich. The natural tendency of a tax on windows is to lower rents (not to speak of injurious effects on the architectural beauty of buildings).

The revenue or profit derived from a capital divides itself naturally into two portions, 1st, that which pays the interest ; and 2nd, that which exceeds what is necessary for the payment of the interest. The latter portion cannot be directly taxed, but the former may ; and that without increasing the rate of interest on money. The rate of interest depends solely on the demand for money compared with the supply. It is commonly believed, that the actual quantity of money in a country affects the interest so as to lower it when there is a great deal ; but the contrary has been satisfactorily proved, so that, while the proportion between capital and the demand

for it remains the same, the rate of interest cannot be affected by a tax on the profits of capital. Nevertheless, there are two circumstances which prevent the imposition of a tax on the interest of money. 1st, the amount of a capital in money can hardly be known, if its possessor chooses to keep it a secret; besides which it is subject to constant fluctuation. 2nd, one may export one's capital to a country where the interest it bears is not taxed, and thus deprive one's own country of the benefits that would have accrued from the employment of the exported capital. A consequence greatly to be dreaded.

Wherever such a tax exists, how is it imposed and in what proportion; how is it collected and what does it produce to the treasury of the country?

There are taxes which bear principally on the profits of certain industry, these fall ultimately on the consumers; it may nevertheless be unequal; as, for instance, when large and small dealers are taxed alike; notwithstanding which, this inequality is sometimes an advantage, as where it is desirable to limit the number of small retail spirit dealers, &c. Care must be taken, however, not to fall into the opposite extreme, which would convert large dealers into great monopolizers, to the injury of consumers. It is, moreover, very difficult to distribute such a tax with equality; for there is often more business done in little shops than in large ones. A tax on shops, therefore, can never be an equal tax, unless recourse were had to the most annoying measures, such as the frequent domiciliary visits and examinations of appointed agents. If such a tax exists in a country every thing regarding it should be noted; with the sum to which it amounts annually, and the consequences which result from it.

There is another kind of tax imposed upon the presumed profits of those who hold lands of others by farmage or lease; this kind of tax, under the name of *taille personelle* produced in France in 1775 upwards of forty millions of livres: It is, however, the tax in which, of all others, the maxims above alluded to are the most neglected. It tends in a thousand ways, says Smith, to discourage agriculture, and consequently to dry up the principal source of the wealth of a country.

A Capitation tax is also very bad, it is sometimes levied on free men, or only on serfs; sometimes on both. In the first case, it is a bad kind of tax, for it is often arbitrary; and when levied upon serfs or slaves, where the land cannot be

cultivated without them, it is as injudicious as a tax on beasts of labour. The tax on slaves, says Smith, falls wholly on the planters, as they are at the same time owners and farmers; but we are of a different opinion, and to us it appears clear, that a tax on slaves falls ultimately on the consumers of the articles furnished by the planter.

A tax on servants is a tax on expenditure, and therefore assimilates with a tax on articles of consumption: this tax bears heaviest on the middle classes.

The conveyance of property of all kinds by inheritance, and of immoveables, as land, houses, &c., between persons living, is taxed in certain countries, and, in the first case, may be so directly; whereas, in the second case, it can be so only indirectly, by means of stamps and registration.

Inheritances are frequently taxed, but in different proportions, according to the relationship of the heirs and other circumstances.

In some countries, the charge of stamps is regulated according to the nature of the act; in others, according to the value of the property transferred, and in some places, as in Holland, the duties on stamps and registration is determined either way according to circumstances.

The tax or duty on the conveyance of property by will, falls ultimately, as well as immediately, on the person to whom the property is transmitted. The duty on the sale of lands, and old built houses falls altogether on the seller; that on newly built houses falls on the buyer. The duty on stamps and registration of contracts for loans of money, falls wholly on the lender; the duties of like kind in law proceedings falls entirely on the parties pleading; they diminish for both parties the value of the disputed object.

In general, duties on the transfer of property, of whatever kind, are more or less disadvantageous, as they encroach upon the capital of those who entertain none but productive labourers, to increase the revenue of the sovereign, who entertains scarcely any but the unproductive class. Taxes of this kind, however assessed, are always injurious.

The stamp duty on playing cards, though classed with the duties above mentioned, are of a very different nature.

In general the traveller should observe whether, in the country he examines or would describe, there are any duties or taxes imposed upon the transfer of property; and if so, in what cases, under what circumstances, and under what conditions, is the assessment made; what this kind of

tax produces annually, and its consequences on the general prosperity of the country, or on that of certain classes, or on particular branches of industry; in a word, all the details which may be interesting on this subject.

The salaries of workmen are every where regulated by the demand for labour and the mean price of provisions. So long as these remain the same, a direct tax on the price of labour can have no other effect than that of raising it a little; but there are cases in which such a tax is most injurious and absurd; notwithstanding which, it exists in several countries. As it is differently imposed in different countries, it is necessary to observe how it is regulated; what proportion it bears to the salary; whether every kind of labour be taxed alike or differently, and the reason of such diversity; whether some kinds of labour are quite exempt from taxation, and which; on whom the principal weight of the tax falls; what it produces annually; its effects on industry in general, and on certain branches in particular.

The taxes which bear indistinctly on all kinds of revenue are a *Capitation tax*, and the *taxes on articles of consumption.*

With regard to a capitation tax,—having already mentioned it, we will merely add, that it rarely produces so much as was expected from it.

As for taxes on articles of consumption we have spoken of them generally under the article *Excise.* Sect. COMMERCE. We shall, however, give in this place, a few more details on the subject. The distribution made by Adam Smith, between objects of necessity and those of luxury, appears to us hardly admissible. He calls strong liquors, beer, and wine, in countries where the latter is the ordinary beverage, objects of luxury; for, says he, "a man may abstain from these without incurring the slightest blame." This is true, but for a porter in London, beer is as necessary as the shirt on his back. Hume defines luxury "Great refinement in the satisfaction of the senses." We shall not, however, enter into any discussion of the various definitions of luxury. It is clear that every article of consumption is either necessary or superfluous; the extremes are well known, but it is difficult to determine where necessity ends, and superfluity begins. It is evident that a tax which bears upon objects of consumption generally, must bear upon those of absolute necessity, as well as upon those of the most refined luxury.

A tax upon objects of necessity raises the price of labour in proportion.

A tax on objects of luxury does not necessarily raise the price of labour. Adam Smith, considering porter as a luxury, says, than when the price of this article was raised it did not raise the price of labour, but this we think may be in some measure attributed to the diminution in the price of sundry other articles consumed by the working classes; a diminution resulting from the perfection and multiplication of machinery, and which allowed the labourer to consume as much porter as before, without any augmentation of his salary. In fact, workmen receive in the way of salary only as much as is necessary for their maintenance. If then any object of ordinary consumption should be raised in price, their salary must necessarily rise in proportion, unless some other object or objects are lowered in price, so that the general expenditure remains the same.

Wherever there exists a direct tax on objects of consumption, whether it be on those of absolute necessity or on objects of luxury, a note should be taken of the objects taxed, of the rate of taxation, and the sum which each furnishes annually to the treasury. How is the tax imposed; does the consumer pay an annual sum, and what, for the privilege of consuming certain commodities, or are the articles themselves taxed, while still in the hands of the merchant or dealer, before selling them to the consumer? Some objects are more advantageously taxed according to the first, and others according to the second mode. In some countries both modes exist simultaneously. The greater number of taxes and duties on objects of consumption come under the head of Custom-house and Excise dues; of which we have already spoken; for although in different countries they may bear different names, in fact they almost all belong to the one or the other class of contributions. Besides the taxes we have mentioned there are others of greater or less importance according to particular circumstances, as, for instance, Transit dues, imposed upon merchandise which merely passes through a country. How are such dues regulated; on what kind of merchandise; when and how are they paid and what do they furnish?

In certain countries *absentees* are taxed; nothing can be more just than this in every respect; but it is a kind of tax not easily determined or collected. It ought to be proportioned to the amount of revenue consumed out of the

country, and this proportion should be greater than on any other revenue, because capital exported, not only impoverishes the country to the amount of the sums exported, but deprives it of the benefit that would accrue from its expenditure at home.

Certain countries, in certain cases, are in the habit of raising money by what is called a voluntary contribution or subscription, in lieu of certain grievous and difficultly-collected taxes. Where such is the case, note the nature of the tax which is by this means avoided ; how the contribution is arranged, and the amount it furnishes.

There may be other kinds of taxes but we think we have named the principal. The reader who would study this subject should consult the works of Smith, Say, Sismondi, Malthus, Storch, &c., &c. As also the memoirs of those statesmen who have written on finance in general, or on particular departments of it.

We will now merely add that besides the partial observations to be made on each separate kind of tax, it should be noted whether or not the system be uniform for all parts of the country ; and, if not, what are the provinces in which a different mode or rate of taxation obtains, together with the nature and reason of the difference ; whether the taxes are collected by government officers or whether they are farmed ; in the latter case, is the price fixed, or is a preference given to the highest bidder ? What is required of him who farms the taxes, and what is the extent and the limits of his authority to enforce the payments ? Are the farmers allowed to become monopolizers of certain commodities ; and, if so, of what, or is this prohibited ? When the taxes are levied by government agents, how is this body organized ; how many tax gatherers are there, and what is their power and their emoluments ; what kind of control is exercised over this class of persons, or do they act arbitrarily ?

All kinds of taxes, dues, rates, and duties of whatsoever denomination, direct or indirect, should be inquired into ; the objects or persons assessed, and the effects of these taxes, &c., on the general industry of the country, or on particular branches of it ; the sums furnished by each to the treasury, and the expense of collecting ; whence the total net produce of the taxes is easily obtained. What are the fixed regulations and the general result, good or bad, of the system and mode of taxation established in the country ?

What is the present annual revenue of the state ; has it

increased or diminished, and to what amount, for the last ten, twenty, or thirty years?

Where services of any kind form part of the revenue of the government, what may be the value of these in money? Would not better service be obtained if that amount were collected in money, and expended in paying for the required service?

What supplies the greatest portion of the revenue? Are the mines of the precious metals, of diamonds, &c., the exclusive property of the sovereign, or does he merely reserve to himself a portion of the produce; in either case, what do these objects furnish annually?

Are fines and confiscations regarded as an important source of revenue, and to what may these amount annually?

Are there any state lotteries, and what do they furnish yearly?

In civilized countries the *letter post* is a source of revenue, and, as such, its produce should here be noted.

In cases where the ordinary sources of revenue are insufficient for the expenses of the state, what are the modes adopted by the government in order to procure more? Does it contract loans; and if so, what are the securities it offers, and the interest it gives? Is the government remarkable for good faith with its creditors, or the reverse?

Is there a national debt; what is its amount, and that of the interest annually paid to the creditors of the state? How has this interest varied at different times; is there a sinking fund, and what is its effect in diminishing the national debt? Does the country owe any thing to any other country, and which; what is the amount of this particular debt; when and on what occasion was it incurred, and how is it paid off?

We have hitherto spoken only of government taxes; there are others that are called rates, and which are local, levied by local authorities, and the produce applied to local purposes; these are generally very different in different places, and are liable to constant variation according to circumstances; their nature and everything regarding them should be noted by the traveller who would obtain or communicate useful observations on the pecuniary burdens to which the inhabitants of a country are subject.

DEMESNES OF THE SOVEREIGN.—Besides the sources of revenue already enumerated, the sovereign, in all

monarchies, possesses lands to a greater or less amount; and the great extent of these may be detrimental or advantageous to the country according to circumstances.

It is evident that, as wealth is power, the greater the wealth of the sovereign, the greater his power; and when this wealth is entailed upon him as sovereign, he is, so long as he shall live or reign, independent of his subjects for supplies, and may commit many acts detrimental to the welfare of the state.

Crown lands are sometimes alienable, and when such is the case, they are found eventually to be greatly reduced; as sovereigns, in order to supply their necessities, are in the practice of selling portions, or give them away in reward of service. This has been the case in England, and the result has been to render the sovereign entirely dependent on the country for the necessary means of upholding the dignity of the crown. In despotic countries, the sovereign, jealous of maintaining his power, seldom alienates the crown lands to any great extent, limiting his generosity to granting, in reward of services, the revenues only of certain lands for a stated number of years or for life.

Besides the alienable domains of the Crown, there are others which, according to the laws of some countries, cannot be alienated by the sovereign, such as the palaces, gardens, hunting grounds, the crown jewels, and plate, &c.

The sovereign may also have private property, subject either to the laws which regulate property in general, or to particular laws; as, for instance, a law declaring that, upon the sovereign's death all his private property, not disposed of by will, shall revert to the state; or that, whatever private property the sovereign may have been possessed of before ascending the throne, becomes state property, and his debts chargeable upon the public treasury, &c.

STATE DOMAINS are those which belong to the state. It is, of course, in Constitutional Monarchies only, that the state can have domains separate from those of the crown. The state domains are administered by particular authorities, and the profits arising from them usually applied to specific purposes.

In certain countries the whole territory is regarded as the particular property of the sovereign, who disposes of it, as well as of the lives of his subjects, at pleasure. Even in civilized states the sovereign occasionally reserves to himself certain portions of conquered countries or provinces,

to dispose of at pleasure; such was the case with Napoleon.

The traveller should note everything connected with Demesnes of the crown and of the state; their origin, extent and nature; the manner in which they are administered and the annual profit they yield. What are the effects on agriculture of the possession, by the crown, of large portions of land? If the peasants of the crown lands are serfs, do they enjoy any privileges beyond those of the serfs of other lands; and if so, what is their nature? Have the state demesnes and those of the crown increased or decreased, and from what causes, &c.?

In some countries the crown exercises certain monopolies which are very lucrative; whenever this is the case the circumstance should be noted; marking the object and nature of the monopoly, what it produces annually, and its effects on the industry of the country.

EXPENDITURE.—The expenditure of the state comprises, in highly civilized countries, the following principal items, viz., Charge of collecting the revenue; the interest of the public debt; the expenses of Civil government, including the sovereign and his family, his and their state and household; the salaries of governors of provinces, &c.; of the justiciary and other branches of administration; of diplomatic agents, and expenses of diplomacy; the maintenance of the army, navy, and ordnance; annuities, pensions, allowances, &c.; bounties; public works; educational and other government establishments, &c. What is the annual amount for each of these objects, and is each proportioned to the greatness and power of the state, to its rank in civilization, to local circumstances and foreign relations, and particularly to the advantages which the country derives from each.

Does the government pay any subsidies to other countries, if so, to what country, and to what amount?

What is the proportion between the revenue and the expenditure and what portion of the fixed revenue enters again into circulation among the public, by the expenditure of the state? Ascertain, if possible, what portion of the expenditure of the state is employed reproductively.

Whenever war, or other particular circumstance, necessitates on the part of the government an extraordinary expenditure, what means are employed to obtain the requisite funds? Is it by additional taxes, if so, of what kind; or by loans;

by the sale of crown or state lands or otherwise; or does the revenue sufficiently exceed the ordinary expenditure to render extraordinary measures unnecessary? Is it the custom of the country to keep in the treasury any sums for extraordinary events?

What is the system of organization of the financial department in general, and the number, rank, salary, powers, and privileges of the persons composing it; the mode of transacting business, and the advantages or the defects, which, with regard to local circumstances, or in comparison with other countries, distinguish this branch of administration? Is perfect publicity given to everything relating to the revenue and expenditure of the state, or are these details kept secret; what are the advantages or disadvantages in either case and their consequences, as regards the stability of the government and the general welfare of the nation, &c.? In a word, it would be well for the traveller, when he can do so, to note in detail the several sources of the public revenue, together with the expenditure and balance; as also everything regarding the financial system in general, its actual benefits, or the errors of the system, with the best modes of correcting the latter. The financial history of a country is always interesting, and, therefore, all information regarding it which can be obtained by the traveller should be noted down.

SECTION V.

LETTER POST.

A French writer says with great truth "The service of the Post is too important to be confided to private individuals; interruptions, negligences and infidelities, in a department where everything depends on the activity and the security of civil, political, and commercial intercourse, would be highly prejudicial to public order and prosperity; and such an establishment as the Post must never be subjected to the chances of the good or bad administration of a contractor; it must, therefore, be included in the number of those public services which ought ever to be confided to the government."

As the activity of correspondence by letter is always in proportion to the civilization of states, it is in those countries where instruction is most general, and commercial relations most extensive, that the Post establishment is the most perfectly appreciated : every inhabitant derives more or less benefit from it, even when he can himself neither read nor write. As it is but reasonable, however, that every individual should pay for an object in proportion to the use or pleasure which he derives from it, so it is proper that every one should individually pay the expense of his correspondence. The postage of letters should, notwithstanding, be as low as possible ; for even, low as it is in general, it becomes an item of considerable importance to commercial houses ; and indeed, when too high, the government loses more than it gains, by reason of the means which are then successfully practised of defrauding the Post establishment of its dues. In almost every country where a letter post is established, the letters of individuals in official situations and of certain rank, are exempt from payment ; this privilege, which at least as regards the correspondence of persons in office, was founded on ideas of advantage to the public service, has generally been abused ; and hence in England, which takes the lead in affairs of this nature, the franking of letters has been abolished, and the rate of postage reduced to the lowest possible charge, and rendered uniform for equal weights, whatever may be the distance.

In some countries the postage is paid by the parties receiving the letters ; in others by those who send them ; in some it is optional. In England, by the new regulations, if the letter be not paid by the party sending, the charge is doubled to the party receiving.

In some countries the post, for a small per centage, undertakes the safe transmission of money. Checks, banknotes, &c. may always be transmitted by post, but unless proper notification be given, and the required per centage paid, the post does not hold itself responsible.

In different countries the transmission of letters is effected in different ways. In some, the bags of letters are carried on horseback ; or, as in Asia, on dromedaries ; in others by regular mails or coaches, carrying also passengers and light luggage ; in others, again, though vehicles are used, they carry nothing but letters and light parcels. For short distances, as in towns, the letters are carried and delivered by men on foot. The horse carriage is of course the most ex-

peditious, but it would be insufficient in countries where the number of letters is very great; or at least the great number of horses that would be necessary, would increase the expense beyond all possibility of remuneration. On particular occasions, however, horses are used as for *Estafettes* and *Couriers*.

With regard, then, to the Letter Post establishment of a country, the traveller should note, in addition to what we have pointed out in the article TOWNS, the circumstances just stated, and such others as will readily occur to him;—as whether letters are paid by weight, or distance, or both; the extreme weight that is allowed, and the rates and mode of payment; the degree of celerity and safety of letter carriage, and whether or not letters are inspected or are liable to be opened and read. How is the administration organized, what are the salaries of the several persons employed, and to what kind of control are they subject? What means are taken to secure integrity on the part of the letter carriers, and how are they punished for abuse of confidence? How is the business transacted at the principal or central office? In a word, note every thing relating to this most important subject.

The quickest mode of conveyance is often insufficient, and hence government intelligence and orders are often conveyed by Telegraphs or Semaphors. When these exist the traveller should note the lines on which they are established, the distances of the stations, the mode of conveying intelligence by day and night signals, and the rapidity with which intelligence is by this means conveyed.

DIVISION VI.

SCIENCE AND LITERATURE.

SECTION I.

SCIENCES.

MORAL PHILOSOPHY.—Of all sciences the first unquestionably is the science of life, or morals. There have been, and still are, various systems of philosophy which, as they are founded on different primary views, seem, in their conclusions, to diverge so much the more as the fundamental principles or premises have differed, and as the reasonings upon them have been more logical. An attentive observer, however, will soon discover points of resemblance in almost all the systems, and that they differ, merely because they are but partial and incomplete views of one and the same object. If the disputes regarding the nature of man were confined to mere theoretical speculation they would be of little real importance; but as it is impossible that our actions and lives should remain uninfluenced by the ideas we have of the nature of man and the intention of his being; so the principles of philosophy acquire the greatest importance from the practical results to which they lead.

There are no societies in existence, not even the most savage, whose principles of action may not be referred to some one or other of the various philosophical systems which have been propounded; but philosophy, as a science, is the result of civilization, and although, where moral philosophy is studied as a science, there is little doubt but that, in many cases, the principles on which it is founded are de-

rivable from the manners and habits of the people; still these very manners and habits are in their turn modified by the predominant system of morality inculcated directly or indirectly in the literature of the country. The literature of a people, therefore, may serve as a criterion of their morals; but we mean at present, to direct the attention of the traveller more particularly to the science of Moral Philosophy as taught in the schools. Observations of this kind, as we have already hinted, can only be made in civilized states; in barbarous countries the traveller will confine himself to discovering the chief principles of action of the nation, and referring them to a particular state of mental development, resulting from causes which he will find it most interesting to investigate.

We have said that, in the various systems of moral philosophy, there are certain points of resemblance; nor can it be otherwise, the object being one and the same,—the greatest sum of happiness. Now, as the nature of man is independent of our ideas of it, the happiness we aim at must be regulated by our nature; and hence all systems of moral philosophy, however much they may diverge in their course, must converge in their conclusion; and, where they do not, men will act agreeably to their common nature and general interests, despite the principles of the schools. Indeed, the precepts inculcated by ethical writers are generally the same; their doctrines differ only as to the motives of human actions and the operations of the intelligence.

Of the various principles which have been chosen by the founders of philosophical sects as bases of their respective systems, we may mention the following, to which all that have existed, however modified, may be ultimately referred: 1. the love of self, or desire of happiness; 2. sociability, or the desire of being useful to our fellow creatures; 3. obedience to God, and the desire of pleasing Him; 4. the desire of acting in conformity with abstract notions of morals; 5. the desire of perfecting ourselves. Now it is easy to see that these are only so many different roads leading ultimately to the same end. Thus, egotism, rightly understood, induces sociability, inculcates obedience to God, and the desire of perfecting ourselves, &c. In like manner benevolence is egotism under another form. Thus, all these several motives of action are good in themselves, and when rightly understood. But the purest doctrines may be perverted, and the various motives of action just enumerated,

when misunderstood, may become corrupt, and lead to the most dangerous consequences.

Every individual, consciously or not, acts from some one or the other of the above principles, or analagous ones ; and the principle, whichever it may be, is ever found to be conformable to his character, his passions, his temperament, or to have been determined by the strong impressions of early education. But the traveller must take an extended view, and although there will necessarily be, in the country he examines, as there is in every assemblage of men, disciples of every school, he will always find that there is one predominating system of moral philosophy. He must therefore observe what this is, and how far it is conformable to the institutions and character of the nation ; whether or not it strengthens, or is opposed to the religious and political doctrines that are taught ; and what influence this agreement or opposition has on the conduct of individuals and the general happiness of the people.

The system of moral philosophy which prevails among a people is almost always the result of their manners and customs ; but the relation is not always equally apparent. The traveller, therefore, will do well to observe by what steps the one has led to the other, and how far the system of morals has remained the same, while the general character and manners of the people may have changed ; or how far the study of moral philosophy has tended to correct the notions of the duties of individuals and of societies, and of the natural rights of man, so as to improve civil and political legislation, and ensure the greatest sum of happiness to the greatest number.

Is moral philosophy much studied abstractedly as a science *per se*, or is it neglected ; is it taught in the schools ; does it form a branch of national education ? What are the writings in which are to be found the most perfect exposition of the principal philosophical system of the country ; has it met or does it still meet with any decided opposition ; and f so, from whom and to what extent, and what is likely to prevail ?

METAPHYSICS.—For a long time the domain of science was a mere metaphysical waste, where those who travelled through it, thought they could discern objects at a distance because they saw nothing distinctly. Fortunately, there sprang up at last a few rational sceptics, who, doubting of the truth of the scholastic doctrines, would no longer

be satisfied with barren speculations and refined subtilty, and who, accordingly, introduced a critical spirit of investigation; they divided and circumscribed the sciences, and each chose some particular object of research to which he confined his efforts. Hair-splitting dialectics gave place to a close examination of nature, and of her operations. The faculties of the intelligence were classed, defined, and limited; men began better to understand the nature of the instrument which they had at their disposition (the mind), and made use of their intellect in the only rational way, by proceeding in their investigations, from the known to the unknown, by experiment and observation; and by this means and a happy application of a few universal axioms, attained a nearer approximation to truth. Principles, rich in beneficial results, very soon covered the vast field of human knowledge with useful fruits, and converted the domain so long sterile into a luxuriant garden of use and beauty.

But from the fact of the scholastic philosophy having given place to a sounder system, we are not to infer the total neglect of metaphysics. Men still continued to investigate the nature and operations of their own minds, the relations of causes and effects, and endeavoured to ascertain the origin of things. The chief difference lay in the mode of reasoning; and as nothing tends more to quicken the intellect, and improve the judgment, than that close ratiocination, which is the more essential as the objects are less palpable, so are we far from approving of that sweeping proscription of metaphysics, advocated by some. There is no doubt that many sound doctrines have been obscured by the metaphysical treatment of them; but this, together with the vain attempt to discover what must ever be beyond the sphere of human knowledge, is the abuse of metaphysics. Truth is the great object of all metaphysical enquiry, and it is impossible to distinguish truth from error, when we argue upon subjects beyond the comprehension of finite minds. But from the fact that metaphysics can lead to nothing in investigations of this kind, we are not to conclude that it is altogether a useless science; such a conclusion would be as absurd, as to deny the utility of a ladder because it cannot serve us to scale the moon.

Whenever proper subjects are treated metaphysically, (and we may observe by the way that the most positive sciences are metaphysical abstractions, when pushed to their extreme

limits,) and such treatment of them leads to truths which the intelligence approves, the science of metaphysics then becomes for the mental eye, what magnifying glasses are for the material organ,—it renders sensible and evident, facts whose existence cannot be denied, though beyond the sphere of our unaided perceptions. It may perhaps be said that we are here confounding metaphysics with logic ; we will not dispute about words ; there is a false and subtle dialectic, as there is sound metaphysical reasoning : it is of the latter we speak.

Metaphysics then, by teaching us to use our mental faculties with acuteness, sharpens the intellect, discovers to us many shades of difference in objects which appear the same, and assimilates objects seemingly different. By these means it corrects the judgment and purifies the taste. There are intellectual truths and truths of sentiment, as well as physical and mathematically demonstrable truths ; and the man whose mind is most susceptible to the former, will be the most likely to make a right use of the latter, so far then is metaphysical science useful ; we speak not of its abuse.

The traveller, in directing his attention to the state of the sciences in a country will not fail to ascertain that of metaphysics, its use or abuse, the degree to which it is cultivated, and the particular objects to which it is directed ; the best works on the science, and its most eminent dead and living professors.

POLITICAL ECONOMY AND LEGISLATION.—Political economy, including the statistical data on which it is, or should be, founded, is comparatively a new science ; though it is now taught in several European universities, and many books have been written upon it ; but nothing can well be more vague and unsatisfactory than the different systems which have been broached, of which there are four principal ones ; 1st, that of the *economists* who founded all their doctrines of national wealth on agriculture ; 2d, that which regards commerce as the main source of wealth ; 3d, that which gives the preference to manufactures ; and 4th, that, unquestionably the most reasonable, which considers all three as equal and co-relative elements of national wealth. But after all, the science, (if that deserve the name which is in fact but a mass of hypotheses more or less ingenious and elaborately elucidated, but continually contradicted by facts,) is most unsettled, and offers very few, if any, axioms of practical application. The elements of the so-called science

of political economy, are in themselves so various and fluctuating, and the circumstances which determine this variation, so difficultly traceable, in many cases, to their primary causes, that it will probably be long ere any invariable principles shall be discovered, which legislation can profit by as a means of increasing national wealth and prosperity.

Indeed the edification of the science has been begun before the necessary materials have been collected; for a long series of statistical data must be obtained before any thing like a right judgment can be formed on many of the subjects of political economy; and it is but as yesterday, even in England, that the importance of such data has been perceived. Therefore, on this subject all that the traveller can do, is, to ascertain as far as possible, to what extent political economy, as a science, is cultivated in the country, and what is the system which prevails and on which the legislation of the country, as far as its industry is concerned, is founded; how long the system has been acted upon, and what have been the results; whether or not the science is generally followed and encouraged; whether it be taught in an abstract manner, dogmatical and positive; or whether care has been taken to modify its doctrines conformably with the locality, the state of civilization of the country, the spirit of its inhabitants, their institutions, &c. This modification is alone capable of rendering the principles of the science applicable; and if it be not national, it cannot but be prejudicial.

The elements of political economy exist in every country, even though the name of the science be unknown; for these elements are nothing more than the national industry and the reaction of its various kinds one upon the other.—To observe this, however, in a manner to arrive at any positive conclusion, requires more time than a traveller usually spends in one place, or can devote to one subject; more particularly if the country has made certain advances in civilization, and is at once agricultural, manufacturing and commercial; for it is not sufficient to observe these industries in themselves, but the influence of climate, laws, religion, manners, government, &c., exercise, each and all, a powerful influence on industry, and complicate the problem to be solved. Many of the particular observations to be made on these matters will be found in the different chapters of the present work.

Legislation.—We have elsewhere treated of the observa-

tions to be made on the practical legislation of the country; we speak of it here as a science. The traveller will ascertain whether laws form a part of the *curriculum* of the universities; whether or not, the rights of man are taught; the Roman law; the canon law; customs; the practice of the courts; the political law, &c. Are these subjects much studied? Is the mass of the people well acquainted with the laws of their country? "Crimes," says Beccaria, "will be so much the more rare, as the text of the laws shall be read and understood by the greater number of men."

MATHEMATICS.—The rigorous demonstrations of Mathematics, which admit of nothing that is vague, have naturally led men to apply its principles to all those sciences which admit of it. Astronomy, Navigation, Geography, Physics, and Mechanics owe the great progress they have made to mathematical formula; even music is susceptible of mathematical demonstration, and Geometry, so essential to the arts of design, by lending its forms and its language to the phenomena of crystallization, has raised Mineralogy to the rank of an exact science. Thus it is, that the almost infinite application of mathematics has constituted it one of the most useful of sciences, and it is accordingly every where taught in civilized countries.

There are two ways of teaching the mathematics, the one analytical, the other synthetical; both have their peculiar advantages. In visiting the universities of a country, its public and private schools, the traveller will inquire into the degree of importance attached to mathematics, and whether the instruction in this science is confined to theory alone, or whether its practical applications are fully developed. Has the country at any time produced, or is there now living in it, any mathematicians of extraordinary ability? Are the mathematics considered essential to the mechanical arts, and therefore generally taught, or are the mechanical arts left entirely to practice and accidental improvement, &c.

PHYSICS AND CHEMISTRY.—Physics, or natural philosophy, is perhaps the most interesting of all the sciences. The study of the causes, hidden to the vulgar, of the innumerable facts and phenomena with which we are surrounded, is an occupation which, while it satisfies the mind, has a happy influence on the heart. He who is occupied with the study of nature has no time for public or private intrigue; and discovering on all hands, order and harmony, his character is improved, while his mind becomes enlightened and his

soul elevated. But independent of these powerful motives to the study of natural philosophy, there is yet another; and one that is still more important to the great mass of mankind,—its practical utility : for, scarcely is a law of nature discovered, but it is immediately applied to the satisfaction of some of our wants : we may also add, that Superstition, the daughter of Ignorance, loses her empire over the mind in proportion as man becomes more enlightened. For these various reasons it is that we find Physics now so generally taught.

What we have said of Physics applies equally to Chemistry, a science which since the establishment of the new nomenclature has led to many important discoveries, and has been of most extensive utility to the arts.

The age in which we live is eminently utilitarian, and science is now only regarded in proportion as it presents useful results ; indeed, it is no uncommon thing to hear many of the discoveries of modern experimental philosophy treated as mere objects of curiosity, but, as experience has amply shown, all such discoveries have been followed by useful practical applications. The power of steam, the phenomena of galvanism, electricity, and magnetism, the polarization of light and its chemical action, are now familiar instances of the truth of our observation. It therefore follows, that, in those countries where physics and chemistry flourish, the useful arts will prosper, and the inhabitants enjoy more generally, the advantages which man has learnt to derive from the properties of bodies and the laws of nature.

The application of steam power, the hydraulic press, the precipitation of metals by galvanic action, by which copper-plates or electrotypes may be multiplied to infinity, with the greatest ease, celerity, and economy ; the lighting of cities by means of gas, the miner's safety lamp, the disinfection of foul air by chlorine, &c., are so many triumphs of modern science, and attest the utility of physical and chemical studies.

The traveller will therefore observe the state of physics and chemistry in the countries he examines, he will particularly notice whether those sciences, generally cultivated, lead to useful applications, and in each case, what are the most important of such that have been made ; or whether, on the contrary, the pertinacity of ancient prejudice prevents the introduction of those useful innovations in art and agriculture, which increase an hundred fold the wealth of a country, and augment the comfort and well-being of the people in proportion.

MEDICINE.—If the increase of the population of a state be an object of the greatest solicitude in countries not already over peopled, every thing which contributes to the preservation of human life must be of paramount interest.

Independent of the inclemency of the seasons and the thousand accidents to which man is naturally liable, there are other causes which operate powerfully on individual health, and are intimately connected with the established institutions of a country. A wise and paternal government, seeks as much as possible to diminish the homicidal influence of a bad climate, and pays particular attention to all those labours which may be injurious to the health of those who execute them.

If in the choice of a spot for building a city, more attention were paid to the purity of the air, the good quality and the abundance of the water ; if in tracing the plan of a city, the breadth and direction of its streets were determined with due regard to a proper circulation of air ; if cleanliness were more strictly enforced, &c., there is little doubt but that the mortality of cities would be greatly diminished. In like manner, if the pernicious consequences which result from the inconsiderate destruction of the forests were duly considered ; if all pestilential marshes were dried up, and stagnant waters carried off, many diseases would be prevented, and much effected for individual happiness and the general advantage of a country. The extreme wretchedness, however, of the lower classes of the people brings them, more than any thing else, to untimely graves, and deprives their country of hands.

These considerations belong to internal policy, but it is curative, not preventive means that are now to occupy our attention. Man, by his very nature, is subject to sickness, and his intelligence, his experience, and his observations, have led him to the discovery of remedies. His first efforts in the healing art were confined to the knowledge of a few simples and their application. In the virtues of a few plants he discovered almost all that was necessary to cure him of the few complaints to which he was liable in his primitive state. The congregating of men in cities, their forced and sedentary occupations, their factitious and unwholesome diet, ridiculous and dangerous habits ; in a word, luxury and refinement of pleasures have considerably increased the catalogue of human diseases, and hence medicine has become a science, and its practice a profession. Philosophy has, to a certain degree, enlightened the progress of the healing art,

which anatomy and the great discovery of the circulation of the blood, have so greatly advanced. But if, on the one hand, the number of able physicians has increased, it cannot be denied that charlatans are still more numerous. It is difficult to decide whether the ability of good physicians at all diminish the prevalence of disease and the number of untimely deaths; but every one must agree that quacks convert the slightest indisposition into an incurable malady, and seldom prolong life.

Of all the sciences none is more difficult than medicine, nor is there any one more important in its results; for when it fails to diminish our sufferings, it unquestionably augments them; and, therefore, no object perhaps claims more attention from a wise legislature than the progress of Medicine. Surgery is a positive art; with a perfect knowledge of the anatomy of the human body, firmness and dexterity, a surgeon is almost certain of the success of his operations; it is not so with the physicians, his science is occult. It is impossible for him to know before-hand, and with certainty, the effect of even the simplest medicines, and so much the more is he in perfect ignorance of the effects that will be produced upon the organs by the numerous drugs, mixed up in all proportions, which he administers. The very diseases themselves, and their true seat, are concealed from him by the great number of complicated symptoms which they present; thus every thing in his art is conjectural, and if we except the discovery of a few specifics really efficacious, such as bark and a few other substances, it does not appear that medicine has advanced in proportion to other sciences. We have seen, it is true, more than one Sangrado, symptoms have been multiplied, and each one, however absurd, has had its day and its partisans.

From these considerations it would appear, that medicine is entirely an empyrical and almost useless science, and those who practise it dishonest men; but it is not altogether thus, and though we have but a poor opinion of the science, we have the highest esteem for many of its professors. The humanity and disinterestedness of many of the medical profession, have reflected the highest honour on the body to which they belong; consecrating their lives to the service of suffering humanity, often without other reward than an approving conscience, they have atoned for the presumption and dishonesty of those unworthy members, from which

their profession, no more than any other, is wholly free. In general it may be said, that if medical science is not what it is to be wished it were, it is less the fault of the Faculty than of the nature of the science itself.

Nevertheless, we may distinguish, even in the curative art, the reasonable from the ridiculous. An exclusive system is bad in every science, in medicine it is dangerous. The wisest amongst physicians, is he who establishes his practice on experience and the observation of nature, whose wholesome operations he endeavours to assist.

The end which every wise administration should propose to itself, in what regards physicians and their art, is, to remove as far as possible the causes of sickness, and to watch with attention over those who pretend to prevent or to cure our bodily ailments.

Besides what may be gleaned from the foregoing remarks, we will point out a few special observations which the traveller should make.

Are there, in the country, any medical schools? Are they organized in such a way that the ablest physicians, men of real merit and ability, are ambitious of becoming professors in them?

What are the studies to be followed, and the examinations to be gone through, to authorize any one to practise medicine? Are the schools maintained at the expense of the government or of private individuals; are they sufficiently provided with all that is necessary for the study of Anatomy, Chemistry, Medical Botany, Physics, in a word, for the study of the medical science generally, and the sciences immediately connected with it.

May every one, duly qualified, follow the practice of medicine? Are there any laws prohibiting all unqualified persons from practising medicine, and are these laws rigorously enforced; are they efficient or defective? Are the apothecaries, compounders and retailers of medicines and drugs subjected to proper regulations, for preventing the evils that may arise from their ignorance or their dishonesty?

Is the publication of medical works and journals encouraged, and do there appear many treatises on particular diseases?

Is there any particular system of medicine followed in the country, and if so, what is that system; is it conformable or not to the nature of the climate, the physical

constitution, the food and general habits, and mode of life of the inhabitants, &c.?

Has the nation much or little confidence in the efficacy of medical science? Do the people still indulge in superstitious notions regarding the infallibility of certain medicaments? Do the people in general know the medical virtues of the common plants of the country; do they apply this knowledge with success; or, being ignorant of this, are they, nevertheless, from poverty, forced generally to treat themselves when ill, and thereby frequently increase their ailments?

Are there in the rural districts many old women who pretend to be possessed of infallible remedies and recipes, and if so, what good or mischief do they do?

What is the beneficial or prejudicial influence of the ordinary food of the people, and particularly of the labouring classes; where it is unwholesome, what kind of change is it possible or desirable to introduce?

Are there any particular manufactures or arts which are prejudicial to the health of those engaged in them, what processes might be employed to render these labours less hurtful?

Are there any endemic diseases, and, if so, to what causes may they be attributed? Have the people any particular modes of treating such diseases, and what are they? What are the most common diseases of the country; and what are those which, being common or known in other countries, are unknown or very rare in the country the traveller is visiting; and to what may this happy exemption be attributed?

Is vaccination known in the country? what attention is paid to its propagation? what does the government do or prescribe on this subject? Can any calculation be made of the probable number of lives that have been saved by this happy discovery, since its introduction into the country? when, and by whom was it introduced? does the small-pox still cause any ravages? Are the people generally favourable to inoculation, for the natural or the cow-pox, or are they opposed to these preventive measures? What public or private establishments are there for the relief of suffering humanity? How are they organized and what influence have they exercised since their foundation? Is there anything yet wanting to be done in this respect, and what?

Are murrains frequent in the country, what animals

do they affect; at what seasons of the year; what may they be attributed to; how are they treated, and what steps are taken to arrest the progress of the contagion?

The success of the medical science in the country will be best shown by the hospital registers, where such are kept, and may be relied on; for they detail the number of the sick, and the nature of their complaints, with the number of cures effected, and the number of those who succumb.

These and every other observation which may suggest itself to the mind of the traveller should be made by him, if he would have a competent knowledge of the state of medical science in any country.

SECTION II.

LITERATURE.

In every civilized country, whatever may be its institutions, there exists a constant relation between the laws, the morals, the customs, the arts and sciences, and literature. The principles which regulate one of these objects, affects all the others, so that it is impossible to arrest the progress of, or effect any changes in, the one without affecting all the rest.

When the institutions of a country facilitate the natural progress of things, and exercise such influence only as is necessary for the prevention or repression of prejudicial excesses and exaggerations, they all advance together towards perfection; wherever, on the other hand, the free development of man's various faculties is impeded by a thousand absurd regulations, everything stagnates or retrogrades; and those governments that unwisely seek their safety by means so opposed to their own best interests, ever recognise, sooner or later, the fatal error of their system. A discontented people, paralyzed efforts, uncultivated fields, ruined manufactures, innumerable bankruptcies, a stagnant

or decreasing population, an impoverished treasury, extensive emigration, hurtful, because not occasioned by an excess of population; such are among the minor evils of those perfidious counsels which would persuade princes, that they can reign in safety only so long as their subjects are brutalized. Let us then render thanks to God, whenever a holier inspiration actuates a sovereign's mind. The time is happily no more, when Royalty dispensed with duties. A higher ambition now fires the rulers of states, who feel, that if to reign be glorious, that glory is great only when it is free men they govern.

Those sentiments of humanity and generosity so noble in themselves, and of such beneficial influence, which assure the happiness of a people and confirm the paternal authority of sovereigns, are the work of civilization, the fruit of long and sad experience;—but to our subject.

The literature of a people, we have said, keeps pace with their laws, their manners, &c. By a natural connexion, these objects all exercise a reciprocal influence; so that it is sufficient to observe the actual state of any one of them, to enable us to judge with tolerable certainty of the rest.

Although the literature of a country be as various as the subjects upon which it is possible to write, the greater number of works, will, however, be on those subjects which bear the closest relation to the character and institutions of the people. Thus, when the press is free, and the government constitutional, there will be a great proportion of political works and tracts, showing the active part which the nation takes in public affairs.

Deliberative and forensic eloquence is in honour wherever the discussion of state affairs and judicial proceedings are public. In such case, the general mind is naturally directed towards everything relating to civil and political right. A crowd of public writers send forth from their retreats their essays on governments, legislation, &c. Each with more or less talent, profits by the liberty of the press, to discuss the advantages or inconveniences of public measures, according as his private interest is benefited or compromised. We shall not stop to consider the beneficial effects or general propriety of the right of this free publication of opinions; whenever it is established, it must, if not abused, be followed by the happiest effects, since it cannot exist but in conformity with the other established institutions of the

country. Be it remembered, however, that as liberty degenerates into licentiousness, that powerful engine, the liberty of the press, when misapplied, becomes a dangerous instrument of destruction, instead of a means of protection. The liberty of speaking and writing cannot, of course, exist under despotic governments, for reasons sufficiently obvious to all.

In free countries, there daily appears a multitude of polemical writings, and the same independence of spirit by which they are dictated, stamps upon them a noble and manly character, which reveals their origin. Nor is the freedom of which we are speaking, confined to writings of any particular kind; it gives birth to works innumerable on every subject. Many readers create many writers, and when much is written, there must, of necessity, be many indifferent and many utterly worthless publications. Competition, however, in literature, as in all else, excites emulation, so that among the great number of writers many will be found of superior talent, and their reputation so much the better established as they have proved themselves superior to their numerous competitors. Vanity leads thousands to over-rate their ability and aspire to literary fame, and the press groans under the accumulation of labour it has to perform. Individual liberty places the greater number above opinion in all that is purely personal, and this same freedom gives each a right to judge of the public actions of public men; hence, in free countries there is much originality of character, and while the most absurd and extravagant opinions and doctrines are tolerated, the acts of public men are fearlessly canvassed and attacked. Every one being free to publish his reveries, the most impracticable projects, the wildest schemes, the most ridiculous systems are found mixed up, in the literature of a free people, with the happiest conceptions and the most ingenious speculations. Whatever is bad is neglected or condemned, what is indifferent is unnoticed; the extravagant and ridiculous is laughed at, but whatever is good meets with attention and is rewarded as it deserves. Each claiming a certain respect for his own opinion, feels bound to respect the opinions of others; hence, there is a degree of urbanity in discussion, and if polemical writings sometimes display bitterness and party spirit, it is generally in those cases only, where the discussion bears on matters intimately affecting the private feelings, prejudices, or interests of

the parties. On other subjects there may be warmth, but it will be tempered with amenity, the reason of which is plain; the discussions are on things, not on their authors. Public opinion, as we have said, has nothing to do with any man but in his public capacity, provided always that he no way violate the laws; and just in proportion as an individual is judged with severity in his public capacity, so is the private life of the individual respected. No where is libel and defamation more severely punished than in free countries, and hence, personality is banished from all public discussions.

Where arts and sciences flourish, it is natural to expect a number of persons will write on these subjects; in a highly civilized country there are many who enjoy leisure, and thus poetry, novels, and other works of imagination will abound; but independent of the fact, that literature and the belles lettres, will be more or less cultivated in proportion to the degree of civilization to which a people has arrived, it is essential to observe that they will be tinctured by the prevalent manners, customs, laws, religion, climate, &c. They are influenced by all the institutions of the country, and in turn, influence them. It is, therefore, under these aspects in particular that the traveller should consider the literature of a people; we will, however, say a word of the principal objects comprised under the general terms literature.

OF THEOLOGICAL WRITINGS.—It is to be hoped that the time is passed, never to return, and which it were to be wished could be blotted out from the annals of the world, when men shed each other's blood for a difference of religious opinion; when self-styled Christians attacked each other in writings full of gall and animosity, and disputed with acrimony and diabolical rage upon subjects as ridiculous as they were indecorous, indecent, and blasphemous. In the present day a spirit of tolerance, the distinctive feature of the age, allows each one to adore the Great Supreme in the way dictated by his conscience, leaving the Divinity sole judge in a cause which no human tribunal is competent to determine.

This toleration, so truly Christian in its principle, so beneficial in its consequences, is a powerful lever in the machine of government, whose action it greatly facilitates, by diminishing useless collision; and thus it is, that what is good in itself brings its own recompence. A tolerant people,

enjoy themselves the peace they give. Of course the greater the toleration, in countries where there are many sects, the fewer theological disputes. If from time to time some dogmatical writings appear, they will be marked rather by a mild spirit of persuasion than by one of bitterness and persecution.

It is, however, to be remarked, that there are different degrees of toleration, and that although every individual may be allowed to follow unmolested the observances of the religion or sect to which he belongs, there may still exist a national religion, or religion of the state; and which the state therefore feels bound particularly to protect as part and parcel of the government. In such case the privileges enjoyed by the members of the national church will be greater or less, according to circumstances. In a country where, by reason of the very limited number of dissenters from the religion of the state, they can have little or no political influence as a body, it were unnecessarily invidious to confer particular privileges on the national church. This is particularly the case in Russia, where, although no less than twenty different religions or sects exist, still the overwhelming proportion in numbers and influence of those of the national faith, is so great, that nothing is to be feared from admitting to an almost absolute equality of rights, persons of every religious creed; and thus the government has all the credit for a system of toleration, the principle of which has in reality little merit. When, on the other hand, the religion of the state, from the comparatively small number of those professing it, is likely to be endangered by the ascendancy of other religions, it has ever been customary to strengthen the influence of the national church, by granting to its members certain political and civil privileges; and as, from the very terms of the proposition, there is a struggle for ascendancy, the dissenting church will not tamely submit to an inequality of rights, and loudly complains of intolerance. In such a state of things theological disputation will be common; nay, even should equal rights be obtained, the approach to equality in numbers, wealth and instruction of the different religious parties, will still induce a struggle for supremacy. This is now pretty much the case in England, and we daily see fresh publications, persuasive, apologetical, or polemical, issued by the contending parties. The full consideration of this subject would be too long; what we have said, however, is far from being irrelevant to the subject of theological

writings as a branch of literature. The greater or less frequency of such writings, and the particular circumstances under which they are produced, will have great influence on their style and manner, which will accordingly be persuasive or virulent, philosophical or dogmatical, &c., and will therefore greatly assist the intelligent observer in forming his conclusions on the actual social state of the country, and its tendency to change.

RELIGIOUS PUBLICATIONS NOT POLEMICAL.—The great abundance of religious works, though it unquestionably argues a great proportion of readers of religious books, is by no means a proof that a people are eminently religious; for if practical religion were common among them there would be no necessity for constantly reminding them of their religious duties. It nevertheless is an indication that profaneness is not the character of the people, and proves them, beyond a doubt, to be of serious disposition. If the religious writings are found rather to inculcate observances than a religious spirit; if they are found to attach undue importance to the least essential duties of religion, those which relate to mere forms of worship and practices ordered by the church, they may be nothing more than an indirect means of promoting the interests of one church in opposition to those of others: the praise of one form of worship being the indirect censure of every other, and by recommending a strict adherence to forms, the various parties are kept distinct from each other, and more firmly united among themselves. This religious *esprit de corps*, which was the object of the many minute observances of the Jewish legislator, may also be discovered to be the actuating principle of many religious writers whose works do not, upon a hasty consideration, appear written with such views. If again, the great number of religious tracts that are published, are found to be intended to convey consolation for the miseries of this life, by directing attention to a future and a happier state, they will be indicative of a general discontentedness among the people. It is too well known, alas! that in prosperity men are little prone to religious reflections, but that when adversity overtakes them they fly to religion as a refuge. In a prosperous state of society there is a general satisfaction and hilarity, and each being contented with his lot, flies from, rather than courts, whatever can remind him of his end; and works of amusement are more welcome than those which teach men how to suffer ills they do not feel. These and many other

conclusions will result from a careful examination of the religious writings of a people.

OF SERMONS.—Sermons are a branch of literature in which the distinguishing disposition of a people may be traced. There is the same difference between the French and English sermons, independent of the tenets of the Catholic and the Protestant religions, that there is between the character of the two nations. Crevier, a French writer, thus points out the difference. "Sermons," says he, "are with us (the French) true oratorical discourses, and not, as with the English, metaphysical discussions, more calculated for an academy than for those popular assemblies which meet in our temples to be instructed in the duties of Christianity, to be consoled, encouraged, and edified." French sermons display a much more florid and impassioned eloquence than English sermons. They are addressed to the feelings, and the oratorical movements allowed to the French preacher have a much greater effect than can possibly be expected from the composed, monotonous expositions of English ministers.

Independent, however, of the characteristic features which distinguish pulpit eloquence, the sermons and religious discourses of different people, depend much, in each country, upon the prevalent fashion of the day; for the dominion of the fickle divinity extends even so far. Thus, whatever style of sermon and preaching is adopted by a favourite preacher is sure to be followed by a host of imitators, so that, as Dr. Blair informs us, at one time a dogmatical style, at another a philosophical style is in fashion; at one time the people will have poetical sermons, at another argumentative discourses or pathetic declamation. Now, the object of a sermon being to make us happier, by making us better, we do not think that dogmatical sermons fulfil this object. A moral discourse delivered with feeling, and founded on the solid basis of the Gospel, can alone produce the desired effect upon the congregation. The traveller, however, must be careful, in considering these matters, to distinguish what may be regarded as the general literary character of the sermons and religious discourses of a people, from what is merely ephemeral and due, as we have said, to fashion. Funeral orations are commonly little better than lying flatteries, sold by want or meanness, to pride and folly; was ever a funeral oration delivered on the death of a poor, but honest man? this questionable honour is reserved for the rich and powerful.

ETHICAL WRITINGS.—The ostensible aim of a great many works, novels, dramas, satirical pieces, &c., is to inculcate morality; and it must be confessed, there is scarcely any work from which some useful lesson may not be learnt, provided the mind of the reader be properly disposed; but we mean to speak in this place of works professedly and directly treating of morals. In examining works of this kind, the predominating system of morals may be gleaned. Of these codes, however, a distinction must be made between what is merely theoretical, and what may be regarded as a faithful exposition of the practical morality of the country.

The more simple the manners of a people, so much the better is morality understood and practised by them, and the more it is practised, the less need is there for the publication of precepts; so do we find that real practical morality is generally at a very low ebb, when a great number of publications are constantly coming out on the subject of morals. A few virtuous men, among the great mass of the vicious, deplore in secret the corruption by which they are surrounded, but others, gifted with greater courage, raise their voice in behalf of morality unknown or despised. Their object is, to persuade, but, to persuade by writing, one's works must be read, and in order to be read they must awaken interest. Ethical writings must, therefore, be treated in the way the most conformable to the disposition of the people. We need not develop this truth; everybody knows that very different methods must be employed to inculcate morality to the French, from those that would succeed with the Germans or the English.

Let the traveller then observe, whether the moral doctrine inculcated, be austere or mild; whether the moralists announce their opinions in a style calculated to captivate the attention, to fix it, and to convince, or if, on the contrary, a dogmatical and peremptory manner distinguishes their writings. And here we cannot refrain from publicly offering the tribute of our gratitude to the philosopher Droz, every page of whose works is a consolation to the afflicted; whose precepts make us happier by making us better, who has himself laid down the principles which should guide a moral writer in these memorable words:—"*Il faut écrire avec sa conscience, en présence de Dieu, dans l'intérêt de l'humanité.*" The moral code of this deep thinker and engaging writer, is so truly Christian, and withal so conformable to the mixed character of weakness and dignity of human nature, that

it will ever find disciples so long as there shall be virtue left upon the earth : may it be widely propagated, and its benevolent spirit become the great moral principle of mankind throughout the world.

NOVELS AND TALES.—These works are very varied in character : of novels, properly so called, the first kind are those which pourtray the manners and customs, the prejudices, the virtues, the vices or the follies of society in general, or of the particular classes into which it is divided. These novels, in which the English excel, are not only highly interesting, as affording the faithful representation of what is going on in actual and every day life, but, when conceived in a proper spirit, and properly executed, are eminently useful. Thus, when they expose the follies and the vices of mankind, and display to us the charms of virtue and propriety of conduct, they may be classed with the most valuable of moral works ; for they are read by thousands who would never open a book professedly treating of morals. The second kind, quitting the region of common life, delights in the extraordinary, and loves to paint the excesses of which the bad passions are capable, and the sufferings to which innocence is exposed. But although in such works the wicked are made to meet with retribution, and the virtuous ultimately triumph, still the events detailed, though possible, are too far removed from the probable, to serve as cautions or examples for our conduct in life ; while, by displaying all the horrors of vice, they sully the innocent mind, and by the stimulus of extraordinary excitement, awaken passions and feelings which can hardly be indulged with impunity. Such works are dangerous in their tendency, rather than beneficial, and when they are common and eagerly read, they indicate a depraved taste, a morbid state of society, which greedily feeds on the most violent stimulants.

A third class of novels, more dangerous still, is that in which, under pretence of exposing the dangers of sensual indulgences, these are rendered so fascinating, that such works have the very contrary effect to what their authors would have it thought they intended to produce. The next kind of novels we shall notice are those called historical novels, a spurious breed which the great talent of Scott has brought into vogue in our own, and which has been greatly multiplied in other civilized countries. Of this kind of writing it may be said, that while the interest of the story is increased from a knowledge of its being founded on facts, it has the dis-

advantage of often misstating those facts and confusing dates and other historical data; nor are we quite sure, whether this disadvantage does not more than counterbalance the advantage of interest in the perusal.

A fourth kind is the so called philosophical novels, the most perfect type of which are those of Voltaire.

A fifth kind are the poetical novels, as Telemachus, the Incas, the Missionary, &c.

A sixth, the didactic, as Rousseau's Emile.

A seventh, the novels or rather romances of knight errantry, such as Turpin, Amadis, Palmerin, King Arthur and his Knights of the Round Table, &c.; a kind which has had its day, but to which Cervantes gave the death-blow in his inimitable Don Quixote.

There are also satirical novels, and religious novels. In a word, novels are merely prose works of fiction, in which, by means of imaginary personages and circumstances, morals, manners, and characters are developed, and opinions promulgated: they, therefore, as we have said, admit of great variety, and from the kind which predominates, the traveller will gain much insight into the character and sympathy of a people; but independent of this, these works must be considered by him as to their literary merit.

TALES are written with the same intention as novels; their object should be to instruct or amuse, or, more properly, to instruct by amusing. Like novels, *tales* admit of great variety; in some, supernatural agency is introduced, as in the Arabian Nights, the Persian Tales of the Hundred and One Days, the Tales of Hamilton, &c. Some are licentious, as those of Boccacio; some satirical, some philosophical, and some didactic, as Miss Martineau's about political economy. Some answer more purposes than one, as the Indian Cottage, of St. Pierre. No kind of writing offers greater advantages for conveying useful instruction and virtuous principles, and no kind of reading is more delightful, than well written tales. The Vicar of Wakefield is perhaps the first of moral tales.

FABLES, which derive their origin from the East, are a species of moral writing known to all. The most perfect work of this kind is beyond question the Fables of La Fontaine. Truths of various kinds may be inculcated by fables, and the traveller will observe what are the predominant subjects and style of the fables of the day, in the country he

examines. It is not always safe, in despotic countries, to speak truth, even clothed in allegory.*

SATIRICAL WORKS.—There are two kinds of satirical works, the one political, the other moral, and both the one and the other may be general or personal. The object of satire is to correct vice by means of ridicule. There is not a more powerful weapon when properly wielded. Political satire is generally found in free countries only, and indeed, it may serve to a certain degree as a measure of the extent of liberty guaranteed by the institutions of the country, or the wisdom of the monarch. Louis XII. of France and Frederick the Great of Prussia, though despotic in their respective states, tolerated political satire.

The general satire of vice, says Marmontel, is "the most innocent and allowable of things," we would add, there is nothing more useful and necessary ; whereas personal satire is the most odious and unallowable.

Political satire bears upon objects of importance, which, as well as vices, should be treated very differently from mere ridicules, follies, and weaknesses. Political satire should be directed against particular facts ; whatever may be reprehensible in the private conduct of men in power belongs to the category of generalities. Every where, and under every form of government, we find more or less the same vices ; but false measures, unsuccessful speculations, and absurd projects, different according to the times, the circumstances, and the country, are so many particular facts which may be legitimately satirized. This kind of satire, then, cannot launch out into generalities without missing its object, while the satire of vice has unhappily a much wider field of action. In employing satire against vice, and the dangerous presumption of the incapable, it must be keen ; as against the bite of a venomous reptile we must employ caustic, in order to destroy the very germ of the evil.

The satire of our follies and our weaknesses, on the contrary, should be gentle and light, and like salt, serve as a pleasant stimulant for what would, without it, be too insipid to be relished. In a word, we find in satire sometimes the

* An honourable exception to this observation is presented in the case of the living Russian fabulist Kriloff, the La Fontaine of Russia, who, despite the boldness of his satire, has received from his sovereign the just reward of his superior talent.

gall which springs from hatred, ill humour, and injustice; sometimes the acerbity that springs from hatred and ill humour alone; and sometimes a kind of bitter sweet which in part disguises ill nature. The wit which merely seasons without predominating, relieves insipidity, and pleases all who have a delicate taste; but from this to the most poignant sarcasm, the bitterest satire, there are many gradations, employed either in conformity with the character of its objects (which should alone determine the kind of satire to be employed in each case), or indicative of the disposition of the party who wields the weapon. Satire should never, or very rarely, be personal. These hints will suffice to guide the traveller in his examination of the satirical writings of a country.

DRAMATIC WORKS.—The prevailing character of the dramatic works of the several European nations is pretty generally known. An examination of these would lead us too far. It will be sufficient to remind the traveller that they may be rendered a powerful means of correcting vice and folly, or may have a tendency the very reverse of this. They are also occasionally employed as a political engine, either in the hands of a government or of a party.

Comedies are of different kinds, those which represent manners, are novels or tales in action; as satirical comedies are satires in action. These latter should never be personal. Comedies of character are the animated pourtraiture, not of any individuals in particular, but of characteristic types, such as the Avare, the Tartuffe, the Glorieux, the Misanthrope of Moliere, the Turcaret of Lesage, &c. These comedies are in fact satires on the vices and follies of mankind, and are eminently moral in their tendency, provided they are conducted with that decency which has so long been wanting on the British stage. Comedies of intrigue and situation are of a different character, and please particularly by the perfect arrangement of the plot, and its various incidents. Besides these varieties in comedy there are others, as for instance the serious comedy, whose name, though it offers a contradiction of terms, sufficiently explains the nature of the class of plays to which it is applied; it is comedy divested of its usual gaiety, but which never awakens the strong emotions peculiar to tragedy; in short, in this respect, comedy has a considerable range between the very serious, or *comédies larmoyantes;* and the very gay, sparkling with wit

and merriment. Comedy also differs according as its characters are drawn from high life, from the middling classes, or the lower orders.

The legitimate object of comedy is to afford useful practical lessons of conduct, by exposing the odiousness of vice, by ridiculing follies, and recommending the social virtues, and this in the way best calculated to make a lasting impression—by means of theatrical illusions approaching to the realities of life.

It is clear that in despotic countries, the censure of the great is not allowed ; but this very negative quality in the comedies of a people, affords of itself, instruction to the intelligent traveller; while in countries where freedom reigns, the comedies that are the most favourably received reflect the character of the people.

Tragedy is an epic poem in action. The object of tragedy is to raise powerful emotions by the faithful representation of heroic virtue ; to stir up within us that noble enthusiasm which inspires lofty deeds, generous and sublime actions. The means which tragedy employs for this purpose are terror and compassion. The misfortunes which are the ordinary subjects of tragedy, spring either from causes within ourselves, or from those which are beyond our control. With the ancients, the system of tragedy was founded on the latter, with the moderns it is founded upon the former. Opinions are divided regarding the respective advantages of the two systems ; but we must not here discuss them, neither can we go into an examination of the various sources of tragical emotion, and the passions they are calculated to affect. The génius and character of a people may be traced, either in the subjects they choose for their tragedies or in their manner of treating them.

There is a kind of popular tragedy, which, though of a less exalted character than that which should, according to some, bear exclusively the name, is yet perhaps more useful in its tendency, in as much as the personages and incidents come nearer to every-day life, than the actions of heroes and extraordinary men. George Barnwell is better suited to the mass of the people than Cato or Julius Cæsar.

Operas are musical dramas, and are either serious, called *opera seria;* or gay, the *opera buffa;* or of a kind between the two, as the opera *mezzo style.* Although there must be unity in an opera, that is, a principal action, to which all is subservient, still music, dancing and brilliant decoration,

are the soul of an opera, and it is, therefore, to these that the chief attention must be paid. In the *grand opera* all is music and song, in the *melo drama,* though music be introduced, there is no singing.

Farces are short pieces full of buffoonery and fun, intended for the sheer amusement of the people. They are sometimes humorous, and not altogether without merit. They run chiefly on representations of clownishness, awkwardness, blundering and tricks, and often afford much scope for genuine wit.

PHILOSOPHICAL WORKS.—Philosophy is divided into moral and natural. Moral philosophy is absolute and uniform in its principles, but relative in its application according to the manners, customs, and institutions of different countries, so that what passes for very moral in one country, appears very immoral in another. The only one true principle of morality is to *do the greatest good to the greatest numbers.* Now as this good is in a great measure relative, it follows, of course, that there will be much variety in the conventional moral code of different nations.

Natural philosophy is that which treats of the natural and physical sciences, and here, as well as elsewhere, we find the intimate relation we have before alluded to between a country and the direction taken by the mass of its inhabitants. The physical geography of a country has great influence on the extent to which natural philosophy is carried, and the branches of it which are particularly studied. In a country abounding in mountains and mines, the metals and minerals are objects of great importance, and, therefore, geology and mineralogy will be extensively cultivated, and there will be many works treating of these subjects. The animal and vegetable kingdoms so universally distributed, offer, more or less, in every country, their riches to man's industry; and according as this industry is more or less advanced, there will be a greater or less number of writings on these branches of natural science.

The phenomena of nature, their physical laws, and the chemical combinations of matter, belong also to natural philosophy, and are, in these days, studied in the most successful manner, viz., by means of direct observation and experiment; but it is chiefly in a literary point of view, that we are now to consider the writings on natural philosophy. Let the traveller, then, observe, whether they are conceived and executed in a manner strictly conformable to the sub-

ject; if the style be pure and concise without being obscure, whether or not they contain those interesting views which invite us to the perusal, and attach us to the study, of these didactic writings. Do the natural philosophers of the country confine themselves to the observation and explanation of facts, without endeavouring to establish ridiculous systems or absurd hypotheses, or is the contrary remarkable in their writings? Eloquence is by no means foreign to treatises professedly written in explanation of nature; thus Buffon has lavished the charms of the finest writing in his works, and has thereby caused them to be read and admired by thousands, who otherwise would never have opened one of his volumes.

HISTORY.—History, with regard to time, is divided into ancient, that of the middle ages, and modern; with regard to its subject, into ecclesiastical, political, of the fine arts, of the sciences, &c. History is also general or particular.

The general history of a country, retraces the principal events of which it has been the theatre, and whatever is connected with these. Particular history is that of the reign of some particular prince, or the circumstantial relation of the events of some particular epoch.

The history of almost every people, generally speaking, does little more than retrace the mode of life and particular acts of the sovereign, the intrigues of the court, or the wars, civil and external, the persecutions, the convulsions, and the revolutions of states. The reason is, that historians consider as worthy of their pen, such events only as are capable of making a strong impression; those peaceful reigns which roll on without noise, appear to them too monotonous and insipid, they hasten over them, delighting particularly, like great painters, in offering to us some harrowing representation; but if the history of troublesome times has more interest in the perusal, that interest is in great measure destroyed by painful reflections on the evils the people have endured; and the observation is a true one, "Happy the people whose history is insipid." It is not that an animated and delightful picture might not be traced of a happy peaceful people; but historians do not generally give us such, or if they do, the very absence of soul-stirring events is a proof of quiet prosperity. It is pretended, that not only is interest excited by the relation of great events, but that such relation is abundantly useful, by the lessons thus given to tyrants and to the people; but we much question

whether tyrants or people have ever profited by example, while it is doing too much honour to the vicious, to secure them a place in the memory of men, even though their names are to be held in execration. It is a pity writers do not take more pleasure in detailing those events which do honour to human nature. How delightful would be the annals of honour and virtue, how glorious to have one's name inscribed in them. Shall we then never see the day when men will be guided by hope instead of fear. At least, if history must detail to us, in all their appalling truth, the crimes of princes and of nations, let it also indemnify us by the no less faithful picture of those rare and glorious exceptions of a few years of happiness. Let the historian, who has made us shudder at his recital of the horrors which have been committed in the world, re-assure us by holding up to our admiration a patriotic sovereign, a grateful and a happy people !

There are two ways of writing history ; according to the first, the facts are stated in their chronological order without comment ; according to the second, which is the more philosophical, the historian, like Hume, Gibbon, &c., does not content himself with a dry statement of facts, but explains them, reasons upon them, and shows their mutual dependance and relation, examines and discusses the various actions of the prince and of the people, censuring the bad and extolling the good. Each of these ways of writing history has its advantages and its defects. We shall not here discuss their several merits, but merely remark, that even when history is confined to a mere relation of events, it is very differently treated in a free, from what it is in a despotic country.

Historians generally compile their works from the written documents furnished by those who are eye witnesses, and often actors, in the events they describe, and who are consequently imbued with the prejudices of the time, and biassed in their judgment by a turn of mind conformable to the institutions which prevailed when they wrote. The compilers of these memoirs expunge from them such facts as are too personal to be of general interest ; but the tone of the history, the aspect under which the events are presented, remains frequently the same as in the original materials ; and hence, not only the same events are themselve differently represented, but the conclusions drawn from them often differ greatly, by reason of the difference in the views, opinions, prejudices and passions of the writers of the materials of history. But we are perhaps extending these

considerations too far, when we remember that the history of all European nations is pretty well known, and our opinions already fixed, both as to the events related and the style and views of the principal historians. Nevertheless as newly written histories are ever and anon making their appearance, the traveller will do well to examine those of the countries he may happen to be visiting, under all their different aspects, as literary productions and veracious chronicles.

POETRY.—Poetry is divided into four principal kinds, *Lyric, Dramatic, Epic, and Didactic.* Thus it is applicable to every subject, notwithstanding which, however, there are some which belong more exclusively to it, or rather, there are certain subjects which, by their nature, are more peculiarly susceptible of being poetically treated.

As for the principal subjects of literature in general we have already said enough regarding them, considering the point of view to which we must confine ourselves. We are now about to speak of a particular manner of treating the different literary subjects, the poetical manner, or poetry. According to the observation of a learned writer, "In order that poetry may flourish in a country, its inhabitants must be gifted with a lively imagination, a delicate and correct ear. Poetry," he adds, "requires a figurative, melodious, rich, and abundant language ; varied in its construction, and capable of expressing every thing,—a language whose various articulations, whose melodious sounds, whose elements, easily compounded in various ways, enable the poet to blend his primitive colours, and to produce from the mixture, an infinity of new and appropriate shades." All these advantages were possessed by the Greeks, and it was with them that poetry attained its highest point of perfection. It would, nevertheless, be a great error to imagine that poetry can flourish only under a serene sky and among a people whose language has a musical prosody.

Pictures, images, and metaphors are the soul of poetry, its elements are in nature, their arrangement in the genius and imagination of the poet. Nature is ever and every where poetical, and genius may spring up under any sky. The Scandinavians have had a poetry as well as the Greeks, and we are almost tempted to regard with Dr. Blair the Fingal of Ossian as very little, if any thing, inferior to the Iliad of Homer.

But although we think that genius may occasionally be

found in every country, it cannot be denied that climate has great influence on poetry. Thus not only are poets more common in some countries than in others, but the nature of the poetry itself is greatly dependent on the climate, and, perhaps still more so, on the institutions of a country. In a country where the institutions are favourable to the fine arts in general, it may be presumed that industry is already in a flourishing state, and that there is consequently a number of persons who enjoy that ease and leisure so favourable to the productions of genius. In such a country there will be a greater number of poets than in another, where the inhabitants are incessantly occupied in obtaining with difficulty the necessaries of life. That the character of the poetry of a people is greatly influenced by the nature of their climate is almost self-evident. In the gloomy climates of the north, the bard sings of the black rocks, crowned with snow and arrayed in clouds, of the waves that dash against the cliffs, of the wan sun, the sickly halo of the moon, the contending corruscations of the northern lights, the melancholy howling of the winds, the night-bird's piercing shriek, &c. Are these objects less poetical than those which inspire the poets of the south? The smiling groves, the meadows enamelled with a thousand flowers of various hues, the pellucid lake reflecting, like a mirror, the objects on its banks, the resplendent sun, the silver moon, the iris, the gentle breathing zephyr, and the nightingale's sweet song, are doubtless charming objects, and the poetical description of them may, by the inspirations of genius, be full of beauty, but the former are sublime.

As for languages, it cannot be denied that some are more musical than others; but for a German, his native language expresses with softness whatever is most touching and tender, as it paints with energy and force whatever is most passionate and lofty.

The first words in the primitive language of man did perhaps convey, by analogy of sounds, the ideas of the objects they represented; but the mutations of language through the lapse of ages has left us very few words of imitative harmony. This is certainly to be regretted, particularly where poetry is concerned; but the ideas of objects and the words which represent them are so identified in the mind, that not only do the words representative of *love*, *hate*, *a rose*, *a serpent*, excite the same ideas and awaken the same sentiments among the different people in whose se-

veral languages they are uttered, but every people conceive these ideas and sentiments better expressed in their own than in any other language. As for poetry, it is in the objects and thoughts themselves, but they must be treated of in a style suited to their nature, or their character is lost.

A *bouquet*, to be beautiful, must in the first place be composed of fine flowers, this is essential; but, in order that these flowers may produce the happiest effect, they must be arranged with taste, so as to blend their hues in one place, to offer striking contrasts in another, and produce a perfect harmony in the whole.

But let us return to our direct object. We are now to speak of the observations to be made on literature in general.

Is literature generally cultivated in the country? Do the writings of various kinds keep pace with each other, or do some kinds abound while others are scarce, what kinds are in either of these cases, and to what may this inequality be ascribed? Are the theological writings of the country marked by a spirit of persecution or toleration? Are the specially moral and philosophical writings exclusive and dogmatical in their character? Is the moral code of the nation mild, indulgent, beneficial, and practical, or severe, metaphysical, and impracticable?

Are the works of imagination, plays, novels, poetry, strictly analogous to the genius of the people, their manners, usages, institutions, character, general mode of life, &c.; if they are conceived in a different spirit, what may be the reason of this anomaly and its consequences?

Do the writers of the country generally aim at the public good in their several productions, or do they seek more particularly for fortune and the praises of the day, by flattering the vices and follies of their countrymen? Are the writings of the country distinguished generally by a national colouring and character, and of what kind; is it gloomy, cheerful, philosophical, witty, melancholy, grave, bold, noble, low, servile, independent, &c., or is each particular kind of writing marked only by its individual character?

Is the language of the country cultivated, purified, and fixed as far as the general civilization of the country will admit? What are the works which are deemed authority for the beauty and purity of the language? Who are the authors who have most enriched the literature of their country, and when did they flourish?

What encouragements are given by the government or by public opinion to men of letters? Is the press entirely free, or is there a censor; if the latter be the case, in what view has it been established, and what are its effects on literature and on the cultivation of the general mind?

Is the trade in books extensive? What are the principal printing establishments, are any particular processes followed in them? Is much attention paid to the perfection of typography, or the reverse? Are foreign works reprinted in the country to any extent? Are there many translations from foreign languages, from what languages particularly, and what are the subjects generally, of the books so translated? Are these translations faithful, does the language of the country admit of an easy transfer of the beauties of other languages, or is its genius so peculiar as to render this impossible? Are books very common in the houses of all generally, or only among certain classes? Are works got up with great attention to beauty of paper, engravings, binding, &c., or is it rather endeavoured to make books as cheap as possible, so as to be within the reach of all?

Such are the principal observations which should fix the attention of the traveller in what regards the literature of the country he examines. His penetration will easily supply what we may have omitted, our object being rather to refresh his memory by hints than to enter into details which ke knows already. Miss Martineau, in her excellent book on "How to Observe Men and Manners," says very justly, "that national literature is national speech, and that without hearing this speech, we cannot judge of the mind of a nation."

DIVISION VII.

FINE ARTS.

SECTION I.

ARCHITECTURE.

In the chapter which treats of towns, we have already pointed out the observations which should be made on the general and particular style of the public edifices, and private houses of a country. We shall here offer a few words on the same subject, but under other points of view, and especially as an affair of luxury, and in relation to the particular taste of the nation.

In Europe, two particular and essentially different styles of architecture are to be found, the Greek, and that erroneously termed Gothic. That style which is called Roman is derived from the Greek, with which it has much in common. The name of the particular style which a building receives, is derived from the kind of columns, proportions, and ornaments adopted in it, that is, its order. The Tuscan order is but a simplification of the Roman doric, or an improvement on the Grecian doric. The Roman doric itself is essentially different from the Grecian in its proportions and capital, and by having a base, which the latter has not. The Ionic is purely Grecian; the only essential alteration made to it in Italy, being in the capitals. The Corinthian is also purely Greek, and is unquestionably the most beautiful of the orders, though its capital is a glaring absurdity. The Composite is a Roman alteration of the Corinthian, and is remarkable for its richness.

Of the Gothic, we shall say a word presently. Of the architecture of other parts of the world, the Egyptian is particularly distinguished by its pyramidal form, the want of parallelism in the upright sides of the openings, as doors, &c., and the colossal dimensions of the edifices.

Indian architecture, which partakes of the Egyptian and the Moorish, is lavish in ornament, and monstrous in its details; but is generally imposing, and often remarkably beautiful as a whole.

Chinese architecture is quite peculiar, whether we consider the distribution and divisions of the plan, the strange forms of the roof, or the monstrous and grotesque figures with which these edifices are ornamented, the brilliant colours with which they are chequered, &c.

These different styles of architecture have their particular merits, either as regards convenience and fitness for the respective countries in which they exist, or as regards taste; for, although there is unquestionably a good and a bad taste, it is in a great measure arbitrary, and very different objects may be in equally good taste.

All pure colours are equally beautiful in themselves, but they may be blended in an agreeable or a disagreeable manner, and cannot be applied indifferently to all objects, so is it with the elements of architecture; the styles which result from these various combinations cannot be employed with equal propriety in all places, and to constructions of different destinations. Thus, what is appropriate in one country would be inconvenient in another; what would have peculiar fitness for one edifice would be absurd in another; what would be strictly proper for a theatre would be preposterous in a temple destined for the worship of the Most High; that which would be appropriate in a saloon of amusement or in the palace of a sovereign, would not do for a prison, a hall of justice, or an hospital, &c. Good taste in all things depends on judgment and fitness. In a word, the counsel given by Leonard de Vinci for painting is equally applicable to architecture:—"Give to each object all the perfection of which it is susceptible, and a character which shall distinguish it from every other object."

It is often erroneously imagined that there is no architecture in an edifice unless it be surrounded with porticos, plastered with pilasters, cut up into salient and retreating parts, flanked with wings, &c. Now, some of the most beautiful specimens of architecture are precisely those

wherein these objects are the most sparingly introduced. The beauty of architecture, however, consists neither in the total absence, nor in the great profusion of embellishments (though, in this respect, much depends on the particular style of architecture), but rather on a happy mixture of simplicity and elegance, beautiful proportion, and a perfect adaptation of the character of the edifice to its particular destination.

Architecture, like every other art, has its principles; and although the chief rules are very limited in number, they are susceptible of almost infinite modifications in their application. In these modifications three things are to be considered, convenience, beauty, and the union of the two. In the construction of private dwellings, convenience is the principal object to be attended to. The sumptuous edifices of the rich and great come under the denomination of palaces; nevertheless, even here, convenience should have the preference over beauty. The construction of a palace is defective when convenience is sacrificed to appearance: it is in the happy combination of use and beauty that perfect fitness consists, without which there is no true beauty in architecture. It will be evident that we take the words use and beauty in a very wide signification, for the former applies to the state-rooms of a palace as to the strictly necessary apartments of an ordinary dwelling-house, and the latter may characterize the simple façade as well as the imposing portico. Fitness consists in this, that no edifice shall have more ornament, nor ornament of any other kind, than is proper for it in accordance with its object.

Climate, soil, and customs modify architecture. The climate by its nature, as hot, cold, temperate, rainy, dry, &c.; the soil by its building productions, stone, timber, clay, &c., and by the solidity or loose nature of the foundation it affords; the customs by the social habits they prescribe, &c. Wealth exercises its influence on the extent and magnificence of buildings; taste determines their embellishments; and judgment presides over the whole.

We repeat that what are termed the *orders*, are only a part of architecture, its ornamental part; moreover, they are known only to Europeans. But, as it is more exclusively in the nature of the ornamental parts of architecture, their proper distribution, and their fit profusion or variety, that taste is most distinguishable, it is in public edifices and

the palaces of the rich, that the taste and judgment of a people as regards their architecture is to be studied.

The public edifices to which we allude are churches, Greek or Gothic; temples; mosques; pagodas; monasteries; bazaars and ornamented market-places, closed or open; caravansarais; town and corporation halls; schools; colleges; libraries; museums and galleries; observatories; porticos; exchanges, where the merchants assemble; barracks; prisons; halls of justice; arsenals; hospitals; lazarettos; hotels; magazines; bridges; aqueducts; triumphal arches; fountains; reservoirs; wells; ports; light-houses; towers; tombs; cemeteries; town gates; large manufactories; theatres; amphitheatres; naumachias; circusses; baths; obelisks; rostral and milliary pillars; monumental columns, statues and edifices; castles; palaces; villas, &c. Each of these objects having a different and distinct destination, it follows, that not only the same ornaments will not be equally appropriate to all, but that in many, no columns or orders strictly so called, should be used, and in some no ornaments of any kind.

The architecture of every edifice consecrated to the Supreme Being should be the most sumptuous imaginable, or perfectly simple; for it is meet either to do everything which shall render such a building worthy of its object, or to make it as simple as possible, in order to indicate that, as nothing sufficiently worthy can be done, it has not been attempted.

It may, perhaps, be objected, that there would be great inconvenience, even if it were possible, to collect into a single edifice all the population of a city, and that no wealth, however great, would suffice for the erection of several temples of such magnificence as we have hinted at. Were we called upon to decide on this matter, there should be in each city a Basilic which, by its size and richness, should correspond as far as man could make it, with the majesty of that Being for whose worship it is erected, and that all other places of worship should be as remarkable for simplicity. To the Basilic the people would go on great occasions, while their ordinary devotions would be performed in the neighbouring temple. The twentieth part of the sums expended for the false and ridiculous decoration of the greater number of churches, particularly in Catholic countries, would be more than sufficient for the erection of a proper Basilic; and the city, so far from being impoverished in the matter of architectural monuments, would, on the contrary, gain much, for

simplicity, instead of being, as is thought by some, inimical to beauty, constitutes its very essence ; and twenty simple but imposing structures might be reared for the price of one gaudy and tasteless production.

The most celebrated Basilics of Europe, St. Peter's at Rome and St. Paul's at London, however admirable as constructions, are, to our taste, wanting in the means of inspiring that feeling with which, in our opinion, the Creator should be approached. Sir Christopher Wren has erected a masterpiece of masonry, but had he lived in the glorious days of Greece he would have produced a masterpiece of architecture.

Gothic cathedrals, particularly in their interior, always invite meditation. We do not at first sight perceive the uncouth ornaments which are heaped together, they are lost in the general effect. We experience a certain vague, undefinable abstraction, analogous to the uncertain light which prevails ; the past recurs rapidly to the mind ; we remember that ages roll on, and that we ourselves pass away with them ; the heart feels oppressed, images of death spring up, we humble ourselves, we kneel, we pray. To explain the relation which this effect bears to its cause is foreign to our object, but that such effect is generally produced on entering Gothic cathedrals, though with greater or less intensity according to the natural disposition of different individuals, cannot be denied, and if we seek not to explain it, neither do we think it that which should be produced by a temple consecrated to the adoration of God. We have ever thought that a God of infinite goodness should be approached with a feeling of confidence rather than of fear ; with a sentiment of joy, not one of despair ; the greater the Supreme Being, so much the more are we ennobled in approaching him, and the more we feel this approach the more the soul becomes elevated, and the more capable we feel ourselves of all that is great, generous, and sublime. But leaving these speculations, let us keep to our strictly architectural considerations.

Gothic architecture is remarkable not only for its pointed arches ; a character it enjoys in common with the Saracenic, but also for its vertical lines, which greatly predominate over the horizontal lines, and the generally slender, aspiring, and pinnacled forms of the principal masses and of the minor details. It is a style too well known, however, to need description. We will here remark that contrary to the very

prevalent opinion, that it had no principles, and that its architects abandoned themselves to all the fancies of arbitrary caprice,—we are convinced, that Gothic architecture had its definite principles, and that these were in many points peculiarly excellent. At all events it cannot be denied, that no buildings display so perfect a knowledge of the very mathematical science of arching and abutment as Gothic cathedrals. The traveller, then, on the subject of these buildings will do well, if he has time and opportunity, to measure all the parts of the plan and elevation of such edifices, when it will be found that some of their dimensions are aliquot parts of others, as of the length or breadth, or of half the length, &c., by means of which a scale may be constructed, serving to discover the module employed by the architect, at least for each separate building; and by the comparison of several buildings, the universal principles which prevailed in the construction of such edifices may be ultimately discovered. The works of Cæsar Casarianus, one of the commentators of Vetruvius, contain observations regarding the cathedral of Milan, tending to show that the Gothic architects worked upon principle, and that this principle was the triangle and its subdivisions. An attempt has also been lately made to discover the principle upon which the cathedral of Carlisle was built, the result of which has been to show, that the circle and its subdivisions were the principle here employed. But as a triangle may be inscribed in, or circumscribed about every circle, it is not improbable that the triangle was the fundamental figure, as in the case of Milan. Why either should have been chosen is not clear unless as symbolical figures. The circle has been often the symbol of the Divinity, but the triangle is more appropriate to the Triune God of the Christians. We leave these matters, however, to the sagacity of our traveller.

Different styles of architecture and different arrangements and combinations of parts, in the same style, have different characters, and by an analogy or secret sympathy, always felt though difficultly explained, awaken corresponding sentiments. Every well organized mind feels the difference between the little and the great; the pretty, the beautiful, and the sublime; the cheerful, the melancholy, the severe and the gloomy. We also know from experience, what are, in general, the forms, the colours, the dimensions and the arrangement which are the best fitted to produce the sentiments we have enumerated; and this knowledge is sufficient

for practical purposes without diving into the metaphysics of the subject. Applying these considerations, then, to architecture, we are enabled to judge with tolerable accuracy from their public buildings, whether a people are influenced by any exclusive sentiment or taste in architecture, and whether or not their judgment in this matter be sound.

Whenever a nation is influenced by a particular sentiment of the little or the fantastical, we find in its architectural monuments, nakedness in the place of simplicity, or tawdriness in lieu of beauty. A frivolous people would have prettiness even in architecture. The really beautiful and the sublime point out a people advanced in real greatness; the former belongs to the peaceful virtues, the latter to the severe and heroic virtues. A cruel and splenetic people would have the gloomy and the melancholy, like the dungeons of the inquisition, or the cloisters of the Trappists. An economical and calculating people, will have nothing but what is strictly necessary; they are sparing of monuments, and such as they have will be plain and solid. A really civilized people, with a sound judgment and purified taste, will have edifices of every character according to fitness for their respective objects.

In connexion with the beauty of public edifices themselves, the choice of their situation is not to be neglected, nor the harmony or contrast of their architectural lines, with the vegetable forms of the country. The harmony of form is observable, for instance, in the aspiring minarets of the Turkish mosques and the pointed cypress trees planted around them, while the horizontal roofs of Italian edifices form a contrast with the vertical stems of the Lombardy poplar, as do also the pointed steeples of our own country with the rounded summits of our oaks and elms, &c. In general, contrast in this respect is more pleasing than harmony, though both may be blended, as at Constantinople, where the flat roof and rounded dome contrast with both the vertical minar and upright cypress. Nor is colour to be overlooked: much of the beautiful effect of buildings is derived from the contrast of their fine stone colour, with the azure of the sky or the green foliage of the trees; while the harmonious keeping of our grey Gothic piles with our cloudy sky and its fitful play of light, has charms peculiar to itself.

These hints, it is hoped, will suffice to direct the traveller in his observations of architecture as a fine art, and in its connexion with the taste and disposition of a people. We

shall therefore close this subject by merely remarking, that though building is one of the arts most necessary to man, and contemporaneous with the settlement of society, still architecture, properly so called, is only to be found in nations rich and civilized.

SECTION II.

PAINTING.

Painting as an art, should be studied in the celebrated schools of Europe, for it is there alone that we can hope to find the truly beautiful or a perfect imitation of nature ; and it is, in fact, to the Florentine, Roman, Lombard, French, Flemish, Dutch, or English schools, that young artists, desirous of attaining excellence, go to acquire the principles of their art. Each, according to his taste or circumstances, makes choice of one or other of these schools, or studies in his own country such of their productions as he can have access to. When launched into practice, he paints such subjects as accord best with his own particular taste, or lends his genius to the production of such pictures as will bring the greatest profit and reputation by reason of the demand; but whatever style or subject he adopts, his *manner* will partake of the school which supplied his first models.

Paintings are a language, and those who contemplate them, read. There should therefore be as perfect an agreement between the subjects of pictures and the taste of those who possess them, as between the books in a library and the disposition of its proprietor. But pictures are objects of luxury, and the wealthy alone can have extensive galleries. The greater the number of originals of celebrated masters of different countries which these collections contain, so much the more are they esteemed ; national productions, forming, generally, but a small proportion in any gallery. Now from the heterogeneous nature of the paintings in such a gallery, it is impossible to discover any feature on which to found a

judgment, either of the taste of the country or of that of the proprietor of the pictures. It is not therefore in the galleries of princes and of the rich, that we are to seek for harmony between the pictorial productions of a country and its mind, but rather in the small collections which adorn the apartments of private individuals: such persons, unable to go to the expense of having foreign paintings, are under the necessity of satisfying themselves with native productions, and the prevailing nature of these will be found more or less characteristic of the prevalent taste, passions, and moral disposition.

Portraits.—In all countries vanity is a common failing, but it assumes different features in different individuals, and in different countries. In some cases it is personal, direct, and undisguised; in others it is diffusive, indirect, and veiled. In countries despotically governed the dignities and honours conferred by the prince are the chief titles to consideration and respect; in old monarchies, where the aristocratic families of the country have played important parts in the history of by-gone times, genealogy and high descent are objects of pride: in republics, places of trust, denoting eminence, are also enviable distinctions; in mixed governments the wealthy ape the great, hence the general prevalence of portraits. In some cases the portraits, displaying with undisguised affectation, the rank, the orders, and other honorific badges conferred on the original, are exposed in the most conspicuous place, proclaiming a greater desire of exacting respect than of deserving it. Not that we would insinuate that we should blush at such well-merited honours as a just, munificent, and enlightened prince may confer, on the contrary, we may reasonably be proud of them; but at the same time it should be remembered, that modesty is the chief decoration of true merit, and a vain display creates a suspicion that more is owing to chance or intrigue than to honour or virtue.

A less immediately personal vanity, and one which, in some cases, is more excusable, is that which makes an exhibition of ancestral dignity. Not that we are for a moment to imagine that we owe these uncouth collections of wigs and conical bodies, of armour and hoops, to filial piety,—that the son delights in contemplating the beloved features of an indulgent father or of a tender mother; for, if such were the motives, these portraits would be confined to the private apartments, whither, accompanied only by recollections and

regrets, he might contemplate them in solitude. No, the truth is, we would usurp by reason of our ancestors a degree of esteem to which we are not ourselves entitled. Nevertheless, as a proper pride in the great and good deeds of our ancestors has a tendency to excite in us a desire of emulating their virtues, this vanity has some shadow of excuse. It may be remarked, that as the first case we mentioned is most common in despotic governments, so the last is more prevalent under limited monarchies, or where feudal prejudices are not wholly extinct ; and wherever it is general, there titles of nobility and musty parchments are more honoured than personal worth.

In these utilitarian days, arts, industry, and commerce, constitute the real greatness of a people. These create wealth, and wealth is power : hence the rich commoner thinks himself the equal of the titled aristocrat, and, as far as money will enable him, must ape the pride of birth, and have the portraits of himself and family ; and as it is a character of vanity to copy those above us, portraits are common from the prince to the yeoman.

It cannot be denied, that one of the chief advantages of painting is to perpetuate, with the remembrance of his illustrious actions, the features of a great man ; but let his country demand the portrait, let it be suspended in a public building, where the multitude may contemplate it, and be inspired to heroic deeds, or learn to appreciate them ; the object is then attained. Let painting retrace the contour of the lips which have smiled upon us, the eyes which have beamed upon us with affection, and let the portrait awaken affectionate sentiments, calm regrets, meditations and hopes, its object is praiseworthy, and the art valuable.

On the subject of portraits, then, the traveller can do little more than note their degree of prevalence, the degree of perfection to which this branch of painting has attained, its progress or decline, and the motives of its cultivation.

Historical Paintings are either princely magnificence or the monuments of a nation's greatness. Man being ever attentive to his individual interest, we cannot be surprised if artists are eager to put upon canvass whatever may serve to illustrate the monarch. Flattery is always agreeable, and painters find their profit in it. So is it to this vanity of princes, to the adulation of courtiers, or to the cupidity of

artists, that we are indebted for those lying pictures which represent sovereigns snatching from their enemies the palm of victory, won in reality by the talents of their generals. Some sovereigns, it is true, have shown greater magnanimity. Thus the Emperor Alexander of Russia has formed a unique gallery of the portraits, which he ordered to be painted, of all the celebrated captains whose names and exploits are connected with the most brilliant period in the history of his reign and country ; but these are portraits, not what we understand by historical painting, the object of which is to preserve the memory of remarkable events, of heroic deeds ; and to elevate the mind by the representation of those actions which are most worthy of esteem and imitation.

Nothing is historical, properly speaking, but that which has happened a long time ago ; but most of the paintings of historical subjects which we possess, are much more modern than these subjects themselves ; the greater part of which are taken from sacred history, and from that of the Greeks and Romans. There are, nevertheless, some fine paintings of subjects from modern history. Our own times are not remarkable for deeds of heroism, and those few which may occur, are not sufficiently appreciated by us to be preserved on canvass for the edification of our posterity. The object is to have pictures merely as pictures, not for the subjects they represent, or the moral influence they exercise, and Watelet observes, with much truth, "Luxury and too great wealth are the most dangerous enemies of painting ; when these two vices of empires have attained their extreme point, works of art enter into the class of sumptuosities, superfluities, mere furniture, subject, like other things, to fashion." This fashion may either determine the predominance of pictures generally, or of a particular class of them, a distinction which the traveller will not fail to remark. When pictures become an essential part of the furniture of houses, they will be in great number, and therefore afford so much the greater facility of judging by their means of the national character. With regard to historical paintings in particular, observe whether they are common or not. Are the subjects taken from ancient history, sacred or profane, or from modern history, or do they represent actions of the present times? and remark particularly the class of actions which such pictures commemorate; such as deeds of mere personal bravery, of generous moral sacrifice, of resignation in adversity,

of national calamities, physical or moral, of great crimes; signal punishments, martyrdoms, pleasing traits of character of remarkable persons, &c.

After portraits and historical pictures we may say a word on sea-pieces, landscapes, bits of architecture, paintings of flowers and fruit, animals, scenes from private life or public manners, or in elucidation of passages from celebrated works, still life, allegories, &c. The latter are sometimes included under historical painting.

These various kinds of pictures are the most common. As various as the tastes of different individuals, they often serve as a true index to the character of their possessors, and hence assist in learning what is the general mind of the nation, and pointing out the favourite pursuits and inclinations of the people. Sea-pieces and Bambochades are common in Holland. The Dutch, a navigating, and almost amphibious people, delight in the representation of every thing connected with navigation, whether upon the seas, or on their canals, or in their ports. This people, whose ideas and actions are coldly methodical, seem to be at the very antipodes of grace. The lower orders know no amusement but what is afforded by the village ale-house, and accordingly the scenes of merriment and drunken riot which these places exhibit, are the favourite objects of the popular paintings ; and certainly, if correct imitation of nature be a merit, the Dutch and Flemish painters have great merit ; nor is this merit confined to their bambochades. Accustomed as the Dutch artists are to the view of the sea, they have produced admirable sea-pieces. The fondness of the Batavians for the cultivation of flowers has also engendered a taste for the representation of these lovely objects of nature, and accordingly many beautiful productions of this kind bear witness to the talent and patience of Dutch artists. The Dutch excel in a faithful imitation of nature, but are strangers to the conceptions of high art.

Landscapes are a branch of painting found every where, and which, more than any other, is influenced by locality. It is very natural that the painter should transfer to his canvass the scenes which he has most frequently before his eyes, and, all else being equal, the more the country abounds in beautiful or picturesque scenery, so much the more will landscape painting be cultivated.

The general aspect of a country exercises a more powerful moral influence than is generally imagined. Watelet

says, "The character of the climate which modifies the scenery of a country, also influences the ideas, the manners, and the occupations of its inhabitants; whence there results a very marked difference in the works of the painters of different countries." This observation is particularly applicable to landscapes, and the same author further says, "The imagination of an Italian landscape painter will naturally be stored with the rich scenery of his country, the beautiful edifices which adorn it, and those imposing ruins which attest the truth of all that historians and poets have written concerning their former splendour; mountains and their torrents, waving hills, lakes and fertile valleys naturally form the ground work of Italian landscapes; noble edifices, temples, monuments old and ruined, or modern and majestic, supply the accessories."

Be it observed, however, that nature in vain offers to artists the most exquisite models, if they know not how to appreciate them. In this respect a very great deal depends on the institutions of a country, which either leave the people in that happy state of feeling, and allow them the leisure, requisite for enjoying the beauties of nature, or paralyze all natural influences by fictitious constraints, or by a sense of social misery. The climate also, by permitting a great part of the day being spent in the open air, or by confining us to our houses, operates powerfully on our sympathy for the beauties of the country; producing, however, contrary or similar effects, according to circumstances. The climate of England keeps people much within doors, and the artificial life of this industrious nation would seem little favourable to a love of the country. But while the necessary attention to business confines the industrious Englishman to his counting-house or his manufactory, and the peer and the parliament man to their attendance at the senate, they fly eagerly for dissipation and health to the rich fields and woodland retreats. A pride also in territorial possessions, a lively interest in agricultural pursuits, and a lurking fondness for baronial life, linked with reminiscences of feudal power, inspire a general fondness for the country and its beauties; and hence landscapes are in great esteem among the English. The French, says Watelet, take no real interest in naval scenes and country manners. Claude and Poussin belong rather to the Roman than to the French school of painting, and of the comparatively few landscapes painted by the French, few exhibit native

scenery; they are imaginary productions or copies of foreign works.

If then artists themselves, whose interest should lead them to study the sites of their own country (and there are few countries which do not afford abundant beauties), pay little or no attention to them, we cannot expect to find in the country a general taste for landscape or the moral sentiments and habits which inspire it. Hence it may be concluded that in countries where landscapes are uncommon, and where those which do exist represent views taken from other countries, the institutions have in a great measure diverted the people from their true interests by inspiring fictitious manners in the place of natural tastes; or that some other cause has operated to draw the general mind from rural labours and country life.

But even where landscapes abound they may be of two very distinct characters, the beautiful or the sublime; that is to say, they may be in the style of the smiling beauties of Claude, or the picturesque sublimity of Salvater Rosa, and according, as the one or the other prevails, we may judge the national character to be directed in preference towards the beautiful and the graceful, or towards the gloomy and the sublime.

England, it must be confessed, is most fortunately circumstanced both morally and physically for excelling, not only in landscape painting but in other branches of the art. From its insular position, the view of the sea is nearly as familiar as that of the land. It is seen at one time calm, at another greatly agitated, or, tempest tossed, urging its foaming billows against the rocky coast. Vessels of all nations, of all sizes and constructions are ever sailing past; no ports in the world offer such variety or such busy scenes: in a word, the English possess every requisite for the composition of the most beautiful sea-pieces. For landscape also, no country is richer in variety of views. The principality of Wales, the north of Scotland, present the most imposing masses of rocks piled into a thousand forms, as various as they are sublime. The county of Cumberland abounds in romantic lakes, and the whole of England is a country most gracefully undulated; its beauties of detail are equally abundant and superior; its vegetation is of uncommon richness; the oak, monarch of the forest, there attains its utmost luxuriance, and contributes greatly to embellish the landscape; cattle, sheep, &c., display the perfection

of their several forms on a background of unequalled green; modern edifices of great magnificence, and the most picturesque views of abbeys and castles are thickly strewn over the face of the country. Health, cleanliness, and content distinguish the person of the peasant, while the comfortable appearance of his cottage harmonizes with the richness of the soil; and finally, if Great Britain does not possess the bright sunshine of Italy, her sky is far better suited for varying the *chiaroscuro* of her admirable prospects. The English should, therefore, and in fact do, excel in landscape painting.

Nor is it for sea-pieces and landscapes alone, that England possesses peculiar advantages; she has also every requisite for the production of the finest historical pictures. The history of no country in the world affords a greater abundance of subjects worthy of the art. Indeed, as Levesque has written, "The English school will be distinguished by the noblest parts of the art, judgment in composition, beauty of form, elevation of ideas, and truth of expression. Beauty will form a distinguishing characteristic of the English school, because it is common enough in England to be constantly before the eyes of the artist. If this beauty be not precisely that of the antique, it is perhaps no way inferior to it. The English school will be distinguished by truth of expression, because national liberty permits the full and natural display of the passions. It will preserve simplicity and not be spoiled by theatrical affectation, exaggeration, and false graces, because the English manners are themselves simple and unaffected."

England moreover possesses a greater number of the finest specimens of the great masters, and talent once acknowledged does not fail of encouragement. With all this, however, neither painting nor the other fine arts are cultivated in England as they deserve to be; the reason for which, as given by artists themselves, fully corresponds with the sentiment of Watelet already mentioned, "That great wealth is an enemy to the fine arts." In England the opinion prevails that enough is done for the encouragement of talent when it is paid, not with esteem and consideration, but, with money only. The nation in general is not imbued with the importance of the fine arts and of their moral influence.

Caricature.—We may add to what has been already said, that, of the different branches of the arts of design, caricature

is, perhaps, that by which we may more readily discern the feelings of a people, the kind of wit which distinguishes them and the degree of freedom they enjoy. Moreover, from the usual subject of these caricatures, we learn what are the most common ridicules of the people, or the vices that are the most odious to them, and which they endeavour, by this indirect but powerful means, to correct or punish.

GENERAL OBSERVATIONS.—There are two principal objects in painting; the first and unquestionably the most important, is to remind us of heroic actions, of traits of virtue and generosity, worthy of our admiration, our esteem, our imitation, and to awaken in us an ardent desire of true glory; or to retrace and rescue from oblivion the features of the benefactors of mankind. The second object of painting is to preserve to us the likeness of those who are dear to us, to offer us a faithful picture of the beauties of nature, and, by delighting our sight with the perfection of form and colour, to inspire us with tender and benevolent sentiments or exalted meditations. Beautiful nature should alone be copied, and where painting is employed to retrace scenes of horror or coarse pleasures, or to pander to an unworthy vanity, art derogates from its object, and the artist degrades himself.

Barbarous nations know nothing of the art of painting (for their rude attempts do not deserve the name), but it does not follow that it is always cultivated in proportion to the degree of civilization. When this is the case the traveller must endeavour to discover the reason. Among those nations where the art is cultivated, some have a decided preference for one particular branch of it, some for another, and this preference is almost always determined by the taste, the passions, and the manners, with which the peculiar class of painting has a general conformity. This conformity should be pointed out where it exists, and its re-active influence on manners. When this conformity does not exist, the reason of this anomaly should be noticed, together with the consequences which result from it.

If the traveller would consider the art, more particularly the following, are, according to Watelet, the objects which should engage his attention:—

1. ORIGIN.—*Natural.* The natural origin of painting is founded on a universal want or bias, which leads man to express what he feels; to designate and imitate. This want or this inclination, which is natural to man, renders the liberal arts necessary to him, and these arts, among which is painting,

become the intellectual languages of the noblest institutions of society, its religious system, its patriotism and heroism.

Historical.—The historical origin of painting is founded on the monuments of antiquity, but these monuments afford but few incontrovertible facts, and are limited to certain epochs. In the most ancient authors who have treated of the history of the arts, may be found a few curious details, which, however, are neither essentially necessary to be known, nor are of much use to the progress of painting.

USE.—*Useful* to the sciences in general, by representing their particular objects.

To history by the representation of facts, by preserving the faithful likeness of objects, of monuments and persons; by the representation of customs and events.

To the institutions of a country, because painting renders them sensible, by placing before our eyes the facts connected with them, or their peculiar allegories.

Useful and Agreeable to the liberal arts, by the relation that painting, which is one of them, bears to the rest.

To the mechanical arts, by facilitating the intelligence, the execution, and the imitation of all that human industry invents; for the art of design is in this respect a universal language.

Agreeable, both in its practice and contemplation, whether from the particular satisfaction which painting gives by its imitations, or as monuments of patriotic deeds, or from the pleasure we feel in the possession of beautiful and valuable works of the arts.

PERFECTIBILITY.—*Theoretical;* by the combination, development and mutual relation of the principles essential to the art; by the assistance derived from other sciences, as from *Anatomy*, which shows the form and arrangement of the bones and muscles;—

By the mathematics which teach the laws of perspective, &c.;

By means of history and fable, where are treasured up interesting facts, and the costumes of the times and of the people,—as also by *allegory;*

By means of observations on the forms of bodies;

By colour;

By the effects of light and shade;

By the effects of the passions;

By the apparent motion of animated bodies;

By the modifications of various kinds, to which visible nature is subject.

Practical.—The habitual exercise of the art, whence ease and freedom in execution.

The choice of the best means, and the use of all the resources which the art allows.

The *improvement* of the implements, and substances used, their preparation, and a perfect knowledge of the uses and properties of all these things.

To which may be added, the encouragement granted by the government, and the emulation which results from public competition.

SECTION II.

SCULPTURE.

Sculptured objects have the advantage by reason of the materials employed, of being much more durable than paintings, though these, if properly preserved, will last a very long while.

Prometheus is presumed to have been the first sculptor (if indeed he was a real personage and not an allegorical personification of the art). He flourished, according to M. Clavier, about the year 1573, and was consequently contemporaneous with Moses, who was born in 1571 before the Christian era. This latter and Sanchoniathon, the most ancient historians known, both speak of sculpture. But however old these authors may be, the art of sculpture is certainly still older, and its commencement, without doubt, dates from the earliest infancy of society.

This sublime art, which had attained its perfection in the time of Pericles, continued to flourish for 600 years, that is, till the reign of Septimus Severus, when it began to decline. During this long period several master-pieces prove that the art was still in its glory. The amorous Praxitelles gave to

the astonished world the divine figure of the beauteous Phryne under the name of the Cnidean-goddess.

Cleomenes struck out that model of grace and beauty the Medicean Venus. Apollonius of Athens sculptured for Pompey, the magnificent statue of Hercules, of which nothing is left but the Torso. The happy reign of Titus gave birth to the Laocoon; and the features of Antinoüs, while they remind us of the friendship of Adrian, are a sufficient proof that the statuary art still flourished at that epoch. But it is foreign to the object of our book to enter into a history of sculpture; to be thoroughly known it must be studied in works professedly written on the subject. Any one who would content himself with a rapid sketch may read the article at the beginning of the second volume of the Musée Français; its author is M. Croze Magnan, and it is remarkably well done. This writer, however, by beginning the history of sculpture with its early progress in Egypt, seems to have paid too little attention to the antiquities of India. The sculptures seen in the Pagody of Elephanta and elsewhere are represented to us as far superior to those of the Egyptians, and their antiquity, according to all appearance, is much greater.

We have said already that the fine arts are intimately connected with each other, so that where any one of them flourishes the others will be cultivated. Thus we see that in the days of Pericles, of Augustus, and of Louis XIV., a simultaneous impulse was given to all the liberal arts, and they were all cultivated in the same spirit. This harmony has always existed, and ever will exist, whence it follows that the series of observations to be made on any one of the fine arts, must be made on them all.

The object of sculpture is the same as that of painting, with this difference however, that the subjects of the former are more limited than those of the latter. Painting can represent every thing, whilst there are, on the contrary, but few material objects, whose form, dimensions, and continuity of texture, admit of their imitation by sculpture.

We know but little regarding sculpture in India, in China and other Asiatic countries, unless it be that the Asiatics as well as the Egyptians, the Etruscans, the Greeks and the Romans, consecrated sculpture more especially to religion. The statues and bas-reliefs of the Asiatics are allegorical representations of the Divinity, or its attributes, and are important monuments of the religious beliefs of these people.

It appears that sculpture, with the early Egyptians, was a kind of language, or rather supplied its place. Figures grossly sculptured and fantastical in their appearance were conventional symbols, stuck up in the public places, where they served, like our placards, to give notice of labours to be begun, of expeditions to be undertaken, &c. Warbarton, Caylas, the Abbé Pluche, &c., are agreed regarding this primitive use of sculpture and painting in Egypt, whence Egyptian antiquities derive additional interest, as throwing much light upon the manners, customs, and early history of these singular people. When, at a later period, a new kind of writing was invented, the primitive signification of these sculptured figures was forgotten; they began thenceforward to deify their statues, whence their theogony and idolatry.

The first statues of the Greeks, were those of their divinities; they afterwards made statues in honour of their sovereigns, heroes, and great men. The Romans followed this example. A praiseworthy motive had given rise to Iconic statues. Friendship, but more frequently vanity and adulation, increased their number, and in our days scarcely any other statues are seen, if we except the copies of those ancient statues which the irruptions of the barbarians, religious persecutions, and the destructive hand of time have spared.

In Christendom, the chief end of sculpture can only be the representation of those persons and actions whose memory is worth preserving, or the personification of the heroic or peaceful virtues; or finally, to present to our view those fine forms and graceful contours, which so appropriately decorate the edifices of a rich and civilized people.

"The beautiful statue of a bright and youthful goddess," says M. Magnan, "inspired love and tenderness, the only affections capable of filling the soul with that ineffable ecstacy which is the characteristic of human felicity." But it is by no means necessary, in order to produce this effect, that the statue should be that of a divinity. The beauty of forms as well as that of colours always produces a sweet serenity, well calculated to lull all discordant, hateful, and cruel passions. The more a people cultivate the fine arts as objects of taste, so much the more common among them *cæt. par.* will be found moral and physical grace and beauty, mildness of manner and goodness of heart.

Whenever a people raise statues to their great men it proves that the people are themselves great and civilized.

Who does not see in the statues raised in England to the memory of the Duke of Bedford, to Watt, &c., the esteem in which the English hold agriculture and the useful arts, and the gratitude of the nation towards its benefactors. And when we contemplate the statues and the monuments raised in honour of Newton, Shakespear, Bacon, Johnson, Garrick, Hume, Chatham, Howard, Pitt, Fox, Burke, Cornwallis, Nelson, Wellington, Jenner, &c., we recognise a people jealous of every kind of illustration.

In every country of civilized Europe, we find, in like manner, statues raised with the noblest intentions, but the number of such statues, and the particular class of virtues they are intended to immortalize, is different in different places, and to this object the traveller should direct his attention.

The statues and monuments of which we have been speaking, are particularly destined for the public, and are in general exposed to the view of all. There are others intended to adorn particular places, such as churches, theatres, palaces, and private houses and gardens. These latter statues must be analogous to the places they are intended to decorate. For churches statues of the Apostles, Evangelists, Saints, Fathers of the Church, Patriarchs, &c. These statues, it is pretended, are Iconic; it is most probable, however, that they bear no resemblance to the individuals whom they are said to represent. Indeed, if the figures and the features correspond with the characters which are held up to us for imitation, their object is sufficiently attained. The traveller will do well to observe how far this may or may not be the case.

We cannot refrain in this place from raising our voice against a practice with which we have always been shocked. We allude to the custom of placing in our churches the statues of warriors, poets, &c. Is it decorous, we would ask, to draw off the attention of the worshipper from God, whom he comes to adore, to objects of worldly vanity? Surely, if men, to be urged on to honourable deeds, require the stimulus of honorific monuments, the temple of the Lord is not the place where these should be erected. A church should be neither a catacomb nor a pantheon.

As for theatres, it is customary to adorn them with statues and bas-reliefs taken from ancient mythology, such as those which represent Apollo, the Muses, &c. They are

also fit place for the busts and statues of dramatic authors and celebrated actors.

Palaces in general, both internally and externally, are adorned with statues, relievos, vases, and other works of sculpture. The statues are either true antiques or copies of these, and of whatever kind they be, unless when collected in a gallery, they should bear analogy to the particular chambers or situations where they are placed. External figures, frequently cast in metal, are either of kings and heroes, or mythological and allegorical personages placed in niches or on pedestals, and sometimes along the tops of buildings.

Statues which adorn the apartments, are the statues or busts of persons for whom we profess a particular esteem, or copies of the antique. None but the very rich can have large collections, and as we have observed, in speaking of picture galleries, little can be learned by such, of the particular disposition of the proprietor; but where only a few objects of sculpture are collected they are generally analogous to the taste of the possessor, and, as with pictures, so by means of the sculptured objects most frequently met with, some judgment may be formed of the predominating taste of the country.

Scarcely any people but the Chinese have sculptured caricatures, unless indeed we regard as such the grotesque figures found in Gothic edifices.

The three arts of which we have just spoken, are the only ones generally understood under the denomination of the fine arts, there are others, however, which are too nearly connected with them to be passed over in silence; such is engraving in all its departments, chasing, modelling and moulding in clay, wax, or other substance, carving in wood, ivory, &c., mosaics and marquetry; in a word, the several arts founded on design.

SECTION IV.

ENGRAVING.

Engraving is to the fine arts, what printing is to literature; it multiplies and preserves the admirable compositions of the great painters, as printing preserves the finest literary productions, the facts of science, and the lucubrations of philosophers. These advantages of engraving have been so justly appreciated that the art was early cultivated, and has been brought to the greatest perfection in most countries of Europe. Genius has discovered a variety of processes, which if they do not all produce effects equally pleasing, have the advantage of severally presenting with greater fidelity the manner of the different masters. Thus Mezzotinto produces a more faithful translation, if we may so speak, of the paintings of Rembrandt, than any other method; and line engraving is better suited to the works of Gerard Daw. Etching again is fitter for the rough touches of landscapes and animals, such as those of Potter; or ruins of edifices, such as those of Piranesi. Stippling answers best for delicate subjects, such as those drawn by Angelica Kauffmaun, and engraved by Bartolozzi; but, when the subject renders it desirable, a clever artist employs different modes in the same piece, and thus produces the finest effect, the nearest possible imitation of a painting, the most spirited representation of nature. Engraving on wood, which has of late years been revived and brought to the greatest perfection is, as every one knows, exceedingly beautiful; and besides being more spirited and better suited for certain objects than any other style of engraving, has the advantage of being printed at the same time with a page of type, and is therefore extensively used for the illustration of books. Lithography and Zincography have lately been added to our means of reproducing objects of design, with this great advantage, that they give numerous copies of the identical drawing by the artist himself; but to crown all, an accuracy of representation hitherto unattainable, has been secured by making nature trace her own image in

the Daguereotype. The infinite multiplicity of engraving by the use of steel plates and cylinders, and by the production of Voltatype plates, are also modern discoveries of the greatest importance in the arts.

Engraving in intaglio, as for seals, dies, &c. ; in relief, as for cornices, &c. ; the engraving of blocks for the printing of calico, paper, &c., though mere mechanical arts, require, in order to be well done, a good knowledge of drawing, skill, patience, and taste. The plastic art, or the making of models in clay, wax, &c., belongs more particularly to sculpture, and requires all the talent and genius of the artist, as, after all, his marble figures are but copies of his clay, or plaster models. The production of mosaic pictures, tapestry, &c., are only mechanical operations, but they require a good eye for colour and much practical ability.

But whatever may be the several objects of the arts of design, they furnish alike a means of judging of the extent and nature of the predominating taste and genius of a nation. Thus architecture, sculpture, painting, engraving in intaglio and in relief, medals, coins, printed and embossed stuffs, embroideries, chasings, inlaying in metal, silversmith's work, jewellery, mosaics, carpets, tapestries, the form of furniture and utensils, vases, and ornaments of all kinds, the costume of the people, &c., &c., are all cognate and characteristic of the national mind, and are therefore, as such alone, highly worthy of the traveller's attention. Should he, however, be disposed to examine more closely into the subject of the fine arts, he must make the following

General Observations.—In what state are the fine arts generally in the country? Are any of them cultivated exclusively or in preference to others, and which; to what may this be attributed? In what spirit are the fine arts generally, or those which are preferred, cultivated?

Are artists treated with the consideration they deserve; are they more desirous of reputation than of fortune; or are they indifferent to fame, except in as much as it is a means of procuring aggrandizement; what is the consequence in either case?

Is there a national school (style) of architecture, of sculpture, or of painting, and if so, what is its distinguishing characteristic; if not, what school is followed, and what is the motive of its adoption in preference to every other?

Are there any public schools, (places of instruction,) for

the fine arts in the country; when and by whom founded; how supported and organized; are they well attended; what celebrated artists have they produced, and what are their several productions? Does the government encourage the fine arts, and if so, what is the extent and nature of such encouragement? How are the productions of the fine arts employed with a view to forming or ameliorating the taste of the nation, and directing it towards the improvement of general morals?

Are the artists of the country, generally speaking, natives or foreigners, and if the latter, why is this?

Is the country rich in collections of foreign sculpture and painting generally, or of a certain class of objects in particular, and which? Have these been obtained by conquest or by purchase; where are they deposited; are they national or private property; are they gratuitously exposed to the public at all times, or only at particular seasons, and when; is the public allowed to take copies of them; what regulations are there on this subject?

Is the love of the fine arts general in the country, or is it confined to any particular class; what are the most remarkable objects in the country, ancient and modern, of foreign or of native production, who were their authors and where are these objects to be seen?

Are native artists drawn away from the country by reason of the greater encouragement offered to them abroad than at home?

Is there observable in the several objects of the arts of design that uniformity of character, which indicates a prevailing taste or a general direction; is this taste permanent, and if so, what is it, or is it subject to the fashion and caprice of the day?

Such, then, are the principal observations to be made on the subject of the fine arts. If it be desirable to give their history, and to consider them in all their relations and bearings, the plan of the synoptical arrangement at the end of the article on painting may be followed, as it applies equally well to architecture and sculpture.

If the fine arts captivate the attention of the traveller, as connected with the morals and present civilization of a country, the remains of past ages should be regarded by him with equal interest, for they are important monuments which throw light on the history of nations.

SECTION V.

MUSIC.

Music, that divine art which acts so powerfully on the feelings of man; which charms his ennui, or which feeds his melancholy; which calms his anger or increases it to fury; which causes tears of tenderness, of love, of pity, to flow, or provokes laughter, joy, and the dance; which accelerates the pulsations of the heart or lulls the senses; which, in a word, according to its various modulations, is capable of awakening all the passions, is more or less admired and cultivated by the whole human race. Some there are who, from defective organization, are incapable of appreciating the art, while the science (for music is a science as well as an art) is understood by but very few; for it is extensive and profound. This ignorance is excusable; but what is not, is the confounding, as is too often the case, of those of its technical terms, which the general cultivation of music has introduced into ordinary discourse, and which accordingly should be understood by all who have any pretensions to education.

The traveller who, on his return to his native country, would give his friends some idea of the state of music among the people he has visited, may do so in a very satisfactory manner when he well understands the value of the terms we have alluded to; whereas without this knowledge, his account would be imperfect or incomprehensible. This consideration induces us to give in this place a few definitions, which we hope will be acceptable to those who may be ignorant of the matter.

Music is the science which treats of the relation of sounds.

These relations are of intensity and duration.

In some languages, these relations are more varied, more multiplied, and more readily appreciated, than in others;

that is to say, some languages are fitter for music, or may be said to be more musical than others.

Melody is the agreeable combination of these relations; it is judged of by the ear.

Cadence is the periodical return of the pauses, or the suspension of sound, after regular and determined intervals of time.

Cadence is judged of by the ear; but it is determined by calculation, and the nature of the subject.

Rhyme is the periodical return of the same sounds.

Melody may be enriched by cadence and rhyme, but is independent of the former as is found by poetic prose and declamation, and of the latter as we find in blank verse.

Rhythm is melody regulated.

The Rhythm of Greek and Latin verse is founded on the duration of sounds or quantity.

The Rhythm of English and French verse is founded on the relation of the intensity of sound, or accentuation.

The more susceptible a language is of transpositions and inversions, so much the greater facility it has of varying the melody and the rhythm of its verses.

The accordance which exists between the sounds of words and the ideas these words are intended to convey, gives additional force to the expression, and produces, together with rhythm, the beauty called imitative harmony.

Strong passions and profound sentiments are averse to cadence, and are shackled by rhyme.

The rhythm of verse should always be analogous to the subjects it paints.

Such are some of the fundamental objects, the attentive consideration of which must regulate all prose composition, aspiring at eloquence, and the prosody of verse of every kind.

Of Song.—The melody of song differs from that of declamation in regard to the duration of the sounds and their higher intonation.

The rhythmic composition of song consequently differs essentially from that of declamation; nevertheless,

The rhythm of song has this in common with the rhythm of declamation, that it must be regulated by the nature of the words and of the subject.

Accompaniment.—Unison is the most perfect and the simplest of all consonances; it consists in the simultaneous intonation of the same note by two or more voices or instru-

ments. In this case it is as a simple sound, or if different sounds are distinguishable, it arises from the different tones of the voices or of instruments.

Simple harmony is the consonance of two notes, the octave of each other; that is, the one being twice as high or as low as the other; or of two notes, the one being separated from the other by an interval of two tones, and hence called a third.

Compound or full harmony is that produced by the consonance of several harmonious sounds.

There are, therefore, three distinct modes of accompaniment, that in unison, the harmonic, and the simultaneous accompaniment of sounds in unison and harmony.

There are two ways of according the rhythm of instrumental music with that of the voice, the one simple, the other varied.

The simple mode is when the rhythm of both, that is their melody and cadence, are exactly alike; this must not be confounded with an accompaniment in unison, for unison is the consonance of the same sounds; whereas two melodies may be, and are in fact, the same, when the sounds which form them, are the same in number and bear the same relation to each other; thus, in accompanying a song note by note; but in an octave higher or lower, the rythmical details of the song and its accompaniment, that is to say, their melody and cadence are exactly the same; and this would form an harmonic accompaniment, and not an accompaniment in unison.

The varied mode is distinguished from the former in this, that while the two rhythms are the same in their principal parts or their cadence, the details or the melody of each particular measure or period is different in the two.

But let us pass on to the observations to be made on the state of music in a country. The information that may be gleaned on this subject, as well as everything connected with the fine arts, besides being interesting in itself, tends to throw light on the morals of a people. The Chinese are so persuaded of the intimate connexion which exists between morals and music, that they say, "Would you know if a country is well governed or not, and whether the morals of the people are good or bad, you have only to consider how music is cultivated in it."

We are of opinion, however, that the character of the music cultivated affords the best criterion.

If music be generally cultivated, we may conclude that the people are contented, be the form of government what it may; that they lead easy lives, are imaginative and susceptible, and that their manners are habitually sociable. All else being equal, the mildness of the climate and fecundity of the soil are favourable to music. The husbandman obtaining his harvest without much trouble, is invited by the serenity of the heavens to cheer his leisure with music and the dance.

Nevertheless, it is observable, that nations, whose position regarding soil and climate is the very reverse of that just mentioned, are equally fond of music. Thus, the Russians are a musical people, and in the long winter evenings of their rigid climate, song and music, of a very simple and primitive kind, it is true, cheer their domestic circles. It is, therefore, less the general disposition to delight in music, than the character of the music itself, which can furnish an indication of the moral feelings of a people. Man in general, and even certain animals, are fond of music, but it is more or less cultivated according to circumstances, so that we should not hastily conclude, because a people do not generally cultivate music, that their morals are corrupt; nor that because they do cultivate it, their morals are good. The English are fond of music, but do not cultivate it generally.* The nature of their climate and soil, together with the institutions that direct their efforts towards industry, do not allow them the leisure which music requires, and yet they rank much higher in the scale of morality than the Italians, remarkable for their music. It would appear, moreover, that the extremes of savage life and of civilization are equally inimical to music. Hunting tribes are not musical, neither are the English. In France it is more general, there the climate is more favourable, and industry less developed. It would seem that the home of music is in the groves of Arcadia and her favourite votaries, its happy swains. But music is more or less universal, and we repeat, it is in its character that we must seek for whatever analogy it may have with the morals and the disposition of a people.

* Of late years music has entered much more extensively into the general system of education than formerly. But to play a little on the piano is one thing, and to cultivate music is another, and a very different thing.

The music of the Chinese, like their character, is grave. A gay and lively people, like the French, have a sprightly music. A people of strong passion, like the Italians, have a music breathing of desire and all the stronger emotions of the soul. The Germans have a sentimental music; the Russians a plaintive melody. The more rural a people, the simpler their music; the more artificial and civilized the state of society, the more harmonious and cultivated will their music be, partaking of the refinement of the other fine arts.

It is among the mass of the people that the national music must be sought, which being generally song, either alone or accompanied, attention should be paid, not only to the melody, but to the sentiments expressed in their ballads.

To give the history of the music of any people is a great labour; to trace out all the moral and physical causes which exercise an influence on the music of a people is, without doubt, a very interesting philosophical exercise, but one abounding in difficulty. The traveller, therefore, admitting as generally true, the fact, that there exists a very marked analogy between the moral disposition of a people and the character of their music, may confine his observations on the subject as follows:—

Is music generally cultivated in the country, or only by certain classes, and which?

What kind of music is cultivated in preference, vocal or instrumental?

What is the character of the national music, is it grave or sprightly, sentimental, plaintive, impassioned, varied, or monotonous in its melody, simple or complicated? Whether is melody or harmony most admired? Do they sing prose, or verse, or both?

What are the usual musical instruments of the country? If there are any that are peculiar to it, what is their construction and capability, and how are they played?

What instruments are preferred?

Is music consecrated to, or employed in, religious worship; and if so, what kind of music?

Is music performed at public and private festivals?

Is there any difference; and if so, what, in the instruments employed on these several occasions?

Does the government encourage music by the establish-

ment of schools where it is taught, or by recompenses granted to those who excel in it?

Does the government endeavour to employ music as a means of moral improvement, and for humanizing the manners of the people?

Is music exercised as a particular profession, and do musicians enjoy any exclusive privileges?

What are the most remarkable facts in the musical history of the country, and who are the individuals who have been the most distinguished for their musical talent?

It is not man, says Monsigny, but the Supreme Creator of the universe who has ordained that there should be in music, *seven notes, three genera, two modes, two measures, and twenty-seven different accords in every octave.* Notwithstanding this law of nature, however, we are not to suppose that all nations which cultivate music are aware of this, as is evident by the variety in the musical scales of their instruments, which the traveller should take care to notice. In a word, he should observe every thing relating to music, both as regards its practice and its theory; ascertain its prevalence, its moral influence, the state of perfection or decay of the art and the causes in either case.

DIVISION VIII.

HISTORY.

Nothing so much increases the interest we take in a country as its history. The traveller, acquainted with the principal events which have illustrated a country; who knows the epochs and the causes of its various revolutions, the spots rendered famous by battles, by treaties of peace, by successes or reverses, finds at every step he takes subjects for meditation and objects of interest. Here meeting with the ruins of a Gothic pile, long the residence of some feudal baron, the terror of the neighbourhood, he is reminded of those dark and barbarous ages in which the few tyrannized over the many. Then coming upon gardens, orchards, and thriving hamlets, where formerly stagnant waters and pestilential marshes spread around their homicidal influence, he blesses the good king, the father of his people, who reigned but for their happiness, and effected those beneficial changes. Here a battle was fought which decided the fate of empires; there was signed a treaty of peace and amity between people that had long been at war with each other. Here was the retreat of a persecuted sage, there a tyrant was put to death; here rose the pyre lighted by fanaticism; further on, there still flows the stream once reddened with the blood of human victims; there was erected by a fanatic people the scaffold of a martyr king; here a woman, superior to her sex, commanded victorious armies; there is the voluptuous retreat that formerly echoed with the revelries of an effeminate prince; there Damiens was torn upon the rack; there the innocent Calas suffered an ignominious death; here torture was first abolished; there, judgment by jury was first established; there perished Nero; there lived Marcus Aurelius; but wherefore this enumeration? Who can travel over Syria without calling to mind the passion of our

Saviour, and who can reflect upon what He suffered for us without becoming better. Who can wander over the classic land of Greece without feeling himself penetrated with enthusiasm for the fine arts. Who can visit the mines of Mexico and Peru without shedding a tear over the fate of Montezuma, Guatimosa, and Ataliba? And thus it is that a knowledge of the history of the country traversed awakens, at every step, interesting objects of meditation.

The history of the several European nations is generally known, as are the principal events of that of the Asiatic nations; but even were this not the case, it is not the province of the traveller to write history; all that he can be expected to do in this respect is, if he be in a country whose history is well known, to satisfy himself, as far as possible, on the spot, and by an examination of such archives as he can get admittance to, of the truth of such historical facts as may appear problematical or obscure.

Whenever a traveller, however, remains sufficiently long among a people little known, he would do well to collect as many materials as possible for their history: with this view, the study of their monuments is indispensable. It is by the examination of these that he will be enabled to judge of the state of civilization to which the nation had arrived when they produced those several objects which come under the denomination of monuments; such as ancient buildings, public and private, &c. It may be observed, however, of buildings, that scarcely any but those of a public nature are preserved for posterity; for these being constructed by the united efforts of the people, or by their sovereigns, are naturally proportionate to the greatness of the means employed in their construction, and they have therefore an extent and solidity which the private fortunes of individuals can but rarely accomplish. Moreover, the objects of their construction being national, the people have naturally endeavoured to render them worthy of their destination, by employing the ablest artists, the most precious and durable materials. Some monuments, it is true, seem to prove nothing but the vanity and magnificence of princes and great men, who perhaps displayed so much the greater wealth and power as the people possessed less of either; but such monuments enlighten us just as much regarding the state of the arts at the time of their construction, as if their object had been quite different.

The public edifices to which we have alluded are such as

Temples, Mausoleums, Palaces, Citadels, Public Baths, &c. Their number shows us the state of morals and religion, and their construction, the state of the arts at the time. We may also mention as monuments of the mechanical arts, such sculpture, engraved stones, coins, paintings, utensils, armour and arms, which have been preserved, despite the ravages of time.

Ancient writings are among the most authentic monuments of the liberal arts and of the sciences. Poetry is one of the first efforts of the imagination; the dramatic art comes later. The subjects of which they both treat, and the way in which they are treated, throw great light in general on the taste of the people.

Scientific writings show the progress of logic or metaphysics, ethics and physics. The first, we need hardly say, treats of the operations of the intelligence, the second of morals, the third of the properties and qualities of bodies.

Where one is fortunate enough to find any writings relating to the laws and usages of a people, they should be regarded as monuments of the most valuable kind, and when, during the first ages of the existence of the people, of whose history we are seeking for materials, they had as yet no written character, we should endeavour to arrive at a knowledge of the signification of their hieroglyphs or symbols, (which often contain the representation of certain ceremonies, or the records of memorable events,) by an acquaintance with their manners and usages, as deduced from the examination and the comparison of their other monuments.

As for hieroglyphs they are of different kinds, those in which we find represented a part of an object for the whole, are called *curiological;* those in which we find an object put for another by reason of the analogy or resemblance that exists between them are called *tropical*, all emblems are of this kind. A third kind, called *phonetical*, have a direct relation not to things but to a spoken language.

As there is an allegorical and an historical antiquity, so there are allegorical and historical monuments. The traveller should be careful to distinguish between them, otherwise he will be likely to commit great errors.

Oral traditions also are deserving of the greatest attention; but great sagacity is required to separate the falsehoods they contain from the truth. It often happens that the most important truths lie hidden under ingenious allegories. In endeavouring to explain them, the traveller

must be particularly guarded against the errors of the imagination, and the spirit of systematizing.

Legends and old ballads, sung by the people, often contain the abridged history of remarkable events. Thus the fall of a tyrant, the disasters of some powerful family, the quarrels of tribes and nations and the results of such quarrels, their reconciliations, the happy or unfortunate loves of monarchs and princes, the valiant feats of chieftains, &c., are all subjects of song ; and as for legends, be their subjects what they may, they always present us with that local colouring which gives so lively an interest to history. We find in them the manners, the customs, the usages, and not unfrequently the very costume of old times.

The traveller will of course attend more or less to these objects, according to the time and opportunity he may have for studying them.

DIVISION IX.

THE COUNTRY CONSIDERED UNDER A MILITARY POINT OF VIEW.

From the earliest times there has been war; indeed perpetual peace and quiet seems, from the experience of ages, to be a vain chimera, which will never be realized: perhaps in the general order of things, this partial evil is a universal good. Be this however as it may, every nation should be in a state to resist the aggressions of its assailants, otherwise it is no longer independent, and independence, with nations as with individuals, is a *sine qua non* of their happiness and prosperity.

The military capabilities and organization of a country are, therefore, objects very worthy the attentive consideration of the traveller; not only for the interest which the subject has in itself, but by reason of the political advantages that may be derived by the traveller's own country, from a perfect acquaintance with the military resources of other nations.

We will therefore say a word on the examination of a country in a military point of view, that is, its offensive and defensive capabilities. These are of two kinds, natural and artificial.

The *natural capabilities* of a country are, its positive geographical position, its relative position as regards other countries, its topography, its climate, and the disposition and courage of its inhabitants. Its *artificial capabilities* are, its land and sea forces, and its fortresses; to which may be added the influence possessed by the country in consequence of its wealth, and its commercial and political relations with

other countries, which latter are of great importance whether for attack, defence, or alliance.

Geographical Situation.—The geographical situation of a country may be favourable or unfavourable, for both offensive and defensive operations, or for the one or the other. Thus, independently of any other considerations, islands are favourably situated both for offence and defence; for the former, because the fleets of the country may sail from a number of points at once, or from such as are most advantageously situated according to the exigencies of the case; for the latter, because an enemy has natural dangers to surmount before he can arrive, and because he can hardly approach without being seen, or land by surprise.

The Morea and other peninsulas are happily situated, for they have the same advantage as islands, except at one point, generally of small extent and easily defended. States situated as are Italy and Spain, are very favourably placed both for defence and attack; for on all sides, except one, they are surrounded by the sea and enjoy in consequence the advantages of islands;* whilst on the sides contiguous to other lands, they are naturally defended by those gigantic ramparts the Alps and Pyrennees. These mountains, it is true, offer equal difficulty of passage from whichever side the attack is made; but the facility of defending the few passes, by which land forces can attempt the invasion of these countries, is an invaluable advantage. Hannibals and Napoleons are not every day found, capable of overcoming all obstacles.

An inland country, naturally defended on all sides but one, is also favourably situated for defence; for such a country may concentrate all its means of defence and resistance on this one vulnerable point; but without such natural defence, a small mediterranean state is most dangerously situated. Hemmed in on all sides by powerful states, ever ready to coalesce in order to seize upon it and divide the spoil among them on the slightest pretence, it has great difficulty in defending itself, while to such a one, offence is impossible.

Countries that are favourably situated for defensive, but are not equally so for offensive movements, are those whose frontiers are protected by large rivers, extensive and thick forests, impracticable marshes, &c. An attacking enemy must be bold indeed to attempt passing the narrow and easily defended defiles, which lie between those obstacles,

* We of course mean the Hispanic peninsula, including Portugal.

and through which the roads are carried. But these countries are unfavourably situated for acting on the offensive, for their armies can *débouche* only by certain known points, and the passage of these is easily disputed. Thus, although they may meet with no resistance while threading their own defiles, a vigorous defence awaits them at the end, and the deployment of their forces is very difficult.

The countries that are favourably situated for offensive operations, without being equally so for defensive, are those which have many points of free exit, but whose open frontier is continually exposed.

Relative Position of a Country.—The advantages and disadvantages of the geographical position of a country are greatly modified by its relative situation as regards other countries. Thus, islands situated on the ocean, fully enjoy the advantages we have pointed out, whereas islands situated in mediterranean seas, though they still enjoy their defensive advantages, are cramped in their offensive operations, if the free passage from the sea to the ocean be disputed.

Peninsulas in the same relative situation have the same disadvantages. The islands of the Mediterranean, the peninsula of the Morea, and Italy are in this case.

Spain, on the contrary, supposing she were mistress of the Straits of Gibraltar, is most happily situated, having her *débouches* on the ocean and in the Mediterranean, she could close or open the straits at pleasure to favour the efforts of her allies, or to add an additional obstacle to the movements of her enemy in one or other of the seas.

The advantages of Russia are also modified by its relative position. Denmark, in possession of the Sound, might protect Russia from an attack on the Baltic side of her empire, or give a free passage to her enemies. Sweden might also attack Russia both by land and by sea. Turkey, in possession of the Bosphorus, can do for the Black Sea what Denmark can do for the Baltic. Austria may also make incursions into the Russian territory. The geographical position of Russia in a military point of view is, therefore, greatly modified by her relative position, and is strong only inasmuch as by possession or alliance, she is mistress of the points mentioned.

Mediterranean states depend entirely on those by which they are surrounded. Their situation is of all the most disadvantageous, as Poland has sadly experienced.

The Topographical Capabilities of a Country.—The continual mutations of empires, the interests of nations, and the ambition of sovereigns are constantly changing the limits of states; thus it very frequently happens that the political frontier does not at all coincide with the natural boundary. Many countries are so circumstanced as to have no natural defences on their frontiers to protect them from the inroads of their enemies; but these, after passing without obstacle the merely political limit, often find, on penetrating a little further, a natural barrier stopping their further progress, or a variety of impediments arising from the nature of the country. These obstacles are mountains, defiles, rivers, woods, marshes, &c., hedges, ditches, walls and other enclosures which, lying in the way of the enemy's lines of operation, retard his progress and divide his forces.

Climate.—The climate of a country is in some cases a very efficient defence; excessive heat, cold or wet, are equally prejudicial to the health of troops not accustomed to such extremes. The burning Sun of the Tropics and the rigid climate of the North are powerful auxiliaries to the people of these countries against the aggressions of all who come from more temperate latitudes.

Disposition and Courage of the Inhabitants.—Amongst the natural means of defence, may be ranged the disposition and courage of the inhabitants. The disposition of a people results from the combined influence of a multitude of local and particular circumstances. We have observed, in speaking of the manners and of the physical constitution of the inhabitants of a country to what an extent climate, laws, mode of life, food, &c. modify directly and indirectly the physical constitution and moral character; without therefore entering into further details on this subject, it will suffice to say, that, generally speaking, a temperate climate, the happiness of the people, under whatever form of government they may be living, patriotism, and a robust constitution, are the principal circumstances which inspire the moral courage and physical energy necessary for the defence of a country.

Having thus briefly mentioned the several natural means of attack and defence which countries may possess: we now pass on to the artificial means; which are land and sea forces, fortresses, &c.

It were needless in this place to compare ancient and modern armies. Every one knows, that after the introduction

of gunpowder, the art of war was entirely changed, and that since then, various systems of attack and defence have been imagined, and different theories broached. We may say generally, that the modern system is that of acting with large masses and a numerous artillery. Victory which, in former times, was the recompense of the individual bravery of the soldier, now chiefly depends on the skilful combinations of the general and the shock of masses.

Superiority of numbers, all else being equal, is an incalculable advantage, not merely for actual combat, but in a stragetical point of view. A general having double the number of troops of his adversary, often opposes to him only an equal number of combatants, but manœuvering with two corps, he has the facility of turning his adversary, or of drawing him, by able manœuvering, into positions where victory is certain. Having a body of disposable troops he may keep his enemy in check with one part of his forces, while directing the other as he chooses, he may force him to abandon his position without striking a blow, and thus arrive at a successful result without effusion of blood. But the principal advantage of great armies to a continental power, is to secure it from attack, while from its threatening attitude it holds in its hands the fate of its less powerful neighbours.

In this respect a powerful army is, in the hands of a wise and benevolent monarch, an instrument of the happiness of millions; he becomes the arbitrator of their disputes, the protector of the weak, and the terror of the ambitious; but in other hands it is the scourge of humanity.

The advantages of a large army, are so well known throughout Europe, that every power would have one; and never was the attention of sovereigns more jealously directed towards the organization and maintenance of armies, even in times of peace, than at present.

The number of soldiers in different countries is far from bearing any proportion to their population and wealth. Thus, we may observe in one an army which becomes burthensome to the nation, by the great disproportion between the expense of its maintenance, and the means of defraying this expense, while in another, we find but a small proportion of the people exclusively devoted to the military career, and paid as such by the state; each citizen becoming a soldier when required. Some nations are essentially military, others again have only such a number of troops as is strictly necessary

for the defence of their country; while others again are so little warlike, that they will hardly take the pains to defend themselves, and are, consequently, the continual victims of oppression.

If the circumstances dependent on climate have a marked influence on the physical constitution of soldiers in particular, the institutions of a country determine in a great measure, the proportion of its military establishments. Thus, countries governed by an absolute monarch, generally maintain large permanent armies, while countries constitutionally governed, have but small armies, with local militia for the maintenance of order in the provinces, and perhaps a few guards for the security and dignity of the regal authority.

Geographical position also modifies the military establishments of a country. Thus, maritime states have both sea and land forces, while the former are useless to a nation having no sea coast or ports. Fortresses are common to all.

Between the operations of land and sea forces, there is a difference which we may here mention. In military operations by land, advantages or difficulties of position are met with at every step, and it is by adapting his movements to the nature of the ground, that an able general renders victory more probable, if he does not by that means secure it. In operations by sea, on the contrary, the field of action (if we may use the expression in speaking of the sea) is the same for both parties.

The main point of military science in operations upon land, is a profound knowledge of strategy, while in operations upon the sea, tactics only are required. The movements of a land army are combined in a thousand ways, while the evolutions of a fleet are very limited. The success of the latter depends on great dexterity in manœuvring and great courage. To gain the wind of your adversary, to place yourself in such a position as to rake him by your broadsides, to board him and snatch the victory by personal valour,—such are the essential points in a naval action, whilst in a battle by land, many calculations of time and distance, many obstacles to oppose to your enemy, or to be overcome by yourself, cause the gain of the day to depend almost as much on the nature of the ground, as on the ability of the commanders and the bravery of the troops.

The land armies maintained by maritime nations depend on their geographical position; in islands they are little required, particularly if they have a navy sufficient for the defence of their coasts. Peninsulas requiring defence both by land and sea, will have both land and naval armaments, the proportion of which, independent of other considerations, will depend upon the extent and nature of their sea and land frontiers.

Fortresses.—With regard to fortresses, their number depends on the nature of the frontiers and the system of defence adopted; but speaking generally, we may say, that since the plan of moving with such large masses as we have seen in these days has been adopted, the system of defence by numerous fortresses has been abandoned. Formerly the frontier of a great European state was defended by a triple range of fortresses; now it is found sufficient to have a few at certain points, where they serve rather as depôts than as obstacles; with the exception however of ports. Intrenched camps have taken the place of fortresses.

Let us now proceed to details; observing, however, that it is the combination of the natural with the artificial means of attack and defence, and their mutual relation, which constitutes the real military strength of a country; for it is clear, that neither the geographical situation, the relative position, the topographical disposition, the climate, nor the courage of the people, nor yet their land and sea forces, nor their fortresses, are any one of them alone sufficient for defence, still less for attack. Thus islands and peninsulas, with all their natural advantages, could never, with these alone, defend themselves against aggression; the largest army can of itself do little for the defence of a country, if its position be open on all sides; for by a coalition of its enemies, and a combination of their movements, they might simultaneously attack it at all points, and so divide the largest army as to paralyze its efforts, or beat it piecemeal, &c. In fact, then, it is the proper relation among each other, of the several circumstances we have mentioned, which can alone constitute real strength. When the traveller would give the detailed military description of a country, he should proceed as follows:—

Military description of a Country.—Indicate the geographical situation of the country and its frontiers at the time of making the description; the advantages or disadvantages which this situation presents; and if, as is often the case,

the conventional frontier is not that which nature seems to have pointed out as the limit of the country, then specify what the latter should be, with the advantages for attack or defence, which would be secured by this natural limit. After having indicated the boundary generally, the particular nature of the frontier should be described.

Frontiers.—The frontier either presents a natural defence such as a maritime coast, a chain of mountains, a great river, immense forests, impracticable marshes, or it is open; or else, as is most commonly the case, it is in part secured by natural obstacles, and in part open; each of these cases demands particular observations.

Maritime Coast.—Is it wholly or in part, of easy or difficult access? what is the extent in either case? Its access is difficult when it is formed of high precipitous rocks, as the Coast of Norway, or of St. Helena; or when it is surrounded by rocks rising to, or near the surface; or when there are sand and mud banks little known, or which change their position; or again, when, being low and shelving, an enemy's vessels must keep at such a distance that cannon cannot protect the landing of troops. It is also of difficult access when it is subject to a high surf, which prevents disembarkation or renders it dangerous. This latter obstacle, however, is, in most cases, only local or seasonal, depending on the conformation of the coast, or the locality as regards the great prevailing currents of the ocean, or on particular winds. When the high surf on a coast is only occasional, the time of year when it prevails, or the winds which produce it, should be stated.

A maritime coast is, on the contrary, of easy access, when it presents none of the difficulties we have specified.

What are its ports, roadsteads, harbours, &c.? What number of vessels, and of what kind, may enter them, and anchor there in safety? What are the favourable winds for entering and coming out, and from what winds are they secure? What is their depth, and the nature of their bottom? Are they defended by forts and batteries, of what kind are they, and what is their strength? What are the parts which, not being defended, should be so? At what particular points is a landing most easily effected. (*See Art.* SEA).

Mountain chains.—A chain of mountains is one of the most advantageous natural defences which a country can

possess, particularly if it be a principal chain; for then its great elevation, its rapid slopes, its narrow defiles, are so many natural obstacles which an invading force has to contend with. Such a chain is, in general, traversed by few great military roads, that is to say, by such as are practicable for artillery and carriages, and its passages are easily defended. The same is the case, more or less, with all mountain chains or groups. The traveller must, therefore, observe the extent and nature of the mountains which form the frontier of a country; the great roads and others which traverse them, where they come from, where they lead to, their length, divided into ascent and descent, and indicated in hour's march for infantry, cavalry, and artillery.

What are their existing natural and artificial defences, and what should be done to improve the former or multiply the latter? Where could the range be most easily passed by an attacking enemy; and which are the best points for defence? If no high road passes the range, and it be desirable that such should be constructed, where should it pass so as to combine the greatest facility of construction, with military and commercial advantages, and easy defence in case of necessity?

Rivers.—When the frontier is protected by a large river, through what extent is this the case, in a straight line and in following the windings of the stream; what is its width in different parts; what is the nature of its banks, and which bank commands the other, generally or at particular places? Is the river fordable at all times or at particular seasons; when and where, and what is the nature of the fords; are they constant in the same place and practicable for infantry, cavalry, and carriages, or otherwise? Are these fords easily defended? What roads large and small cross the river; where do they lead to; what permanent bridges or other modes of passage are there on them; or, supposing the communication interrupted, or in places where no passage is established, how long would it take to organize and effect a passage by means of boats, rafts, &c.? Is the river passable on the ice in the winter; does the river overflow its banks at certain times; or is its rapidity occasionally, or at regular times, such as to render the passage difficult or dangerous? Are there any *têtes-de-ponts* or other fortifications along the river; what islands are there in the river and what is their nature? Are artificial inundations easily effected as a means of defence or annoyance? Are there any ravines or beds of

torrents which *débouche* into the river; where are they situated and what is their nature? are they passable for troops, so that they may come down to the river without being perceived, or, even if perceived, in security from the fire of artillery? What is the extent of such hollow ways, where do they come from; are they wooded so as to be favourable for ambuscade, &c.?

Forests.—When a forest forms the frontier what is its extent; is it a thick forest, full of entangled brushwood, difficult to penetrate, or the reverse; is its soil wet or dry; what roads traverse it, where do they come from and lead to; does the forest terminate at the frontier so as to be wholly within or without the limits of the country, or does the frontier pass through the middle of the forest, and what is the nature of the *débouchés*, &c.?

Marshes.—When a marsh forms the boundary, the traveller should in like manner take note of the extent of the portion which runs along the frontier, and of the particular nature of the marsh; is it equally impracticable at all seasons or only at certain times, and if the latter be the case, during what months of the year; what roads pass it; what is the nature of these roads, and the points to which they lead? Is deployment of troops easy or difficult after passing the marsh on either side; are the roads defended artificially, is the communication easily interrupted, &c.

Open Frontier.—As for such part of a frontier as is open, what is its extent and nature, what fortifications defend it? What roads cross the frontier in this part, and what should be done to increase the defence on this weak side?

Interior of the Country.—The frontier being thus examined in detail the traveller should observe what natural means of defence the interior of the country possesses, supposing the frontier passed by an enemy. But in order to enter into details on this subject, it is necessary to imagine different hypotheses; as for instance the particular object the enemy has in view, the forces he can dispose of to secure that object, the part of the frontier by which he may have penetrated, the particular nature of his army, as well as the strength and nature of that which may be opposed to him. Such hypotheses, however, need hardly be considered but by such only as are particularly charged with drawing up special and detailed memoirs on the subject. To enter into minutiæ would lead us too far, and, moreover, even by multiplying hypotheses, we could never imagine any sufficiently

general to be applicable alike to all countries and all cases. We shall, therefore, confine ourselves to saying, that the general observations on the natural means of defence of the interior of a country should bear, in preference, on the obstacles and military positions which lie along the principal lines of communication. What is the particular nature of these obstacles ; what are the nature, strength, and general advantages of the military positions, are they so combined as to form of themselves, or in conjunction with artificial obstacles, a good line of defensive operations?

Intrenched Camps.—Does there exist, on the principal strategetical lines, any spots favourably situated for the formation of intrenched camps, of sufficient force to require a concentration of all the enemy's forces in order to dislodge the troops before they can be passed; if so, point out their situation and advantages?

Fortresses.—As for fortresses and all other artificial obstacles the following observations should be made. What are the points fortified, and in what view have they been so fortified? How are the fortresses connected, either among themselves or with natural obstacles, to form lines of defence; or, if they are isolated, is their situation well chosen; and, in all cases, do they answer the desired end?

Details of a Fortification.—If it be desirable to have the particular details of any fortified place, the observer should proceed thus. Point out in the first place the particular site. Is it on a height commanding or commanded, or in a plain, near the sea or a lake, on the side of a river, or occupying both banks; or does the site partake of several of these characters? Is the fortress interior or on the frontier; what is its position as regards the principal towns of the country, and its distance from them respectively? Is the fortification regular or irregular, of ancient or modern construction?

Beginning, then, with one of its fronts, and with the most advanced work of that front, it must be considered under two points of view, its plan and its relief. As for the plan, what is the nature of the works and their object; and whether or not is this object attained or missed? what is the actual state of the works, their defences and the state of these defences. With regard to their relief, do they command or are they commanded by other works. Having thus detailed one front, proceed to the next, and so on, till the whole be gone over.

The edifices contained within the fortification should be

divided into public and private ; if there should be any of the latter kind, specifying the nature, extent, and capabilities of each ; the materials they are constructed of, &c. What powder magazines and storehouses are there ; what reservoirs, tanks, or wells, bakehouses, cellars, casemates, hospitals, barracks, &c.

What is the actual strength of the garrison, and the number of men required for the defence of the works ; the quantity of ammunition and provisions existing, and necessary under different circumstances ? How far are the several buildings capable of containing the necessary stores of all kinds ; what amelioration are they susceptible of, and where may others be constructed ?

With regard to water particularly, a most important object, what quantity of water can be contained in the cisterns and reservoirs ; is there at all times a sufficient quantity, and of good quality ; can an enemy deprive the place of water ?

Are there any streams which may be used to cause inundations for the additional defence of the place ; what is the mode of proceeding in order to cause such inundation ?

Are any of the works countermined ; if so, which, and to what extent are the mines carried ?

Finally, how long is the place calculated to hold out in the different cases of attack on different sides ?

Armies.—Is the army permanent, or does it consist only of troops levied in time of war, of a militia force, or is it partly permanent and partly composed of special levies. If we take as a type, a large standing army, organized in the most usual way, its general composition may be enumerated as follows :—

Designation.		Actual number.	Number fixed by the State in times of Peace.	Number fixed by the State in times of War.	Remarks.
Engineers.	Infantry.				
	Cavalry.				
	Artillery.				
Troops of the line.	Infantry.				
	Cavalry.				
	Artillery and				
	Waggon train.				
Garrisons.	Infantry.				
	Artillery.				
Engineers.	Engineers.				
	Pioneers.				
	&c.				
Invalids.					
Irregular Troops.	Infantry.				
	Cavalry.				
Administration.					
Total.					

It should be remarked, that despotic governments have no other rule than the will of the sovereign, and that the very nature of such government requires the constant maintenance of an army ; there is not, therefore, generally speaking, the same difference between the strength of the army in time of peace and in time of war, as in constitutional countries. Moreover there is nothing to limit the extent of the army in despotic countries in time of war, but its resources. In enumerating, therefore, the strength of the army in despotic countries, in time of war, nothing more can be done than to set down the greatest number that have been on foot in the most remarkable wars since the country attained its present extent.

The number of each kind of troops must be indicated,

and by deducting from the total the invalids, and the administrations, whether commissariate or other departments, the remainder will give the number of efficient combatants; from which may again be subtracted the garrisons, in order to have the number of disposable troops for operation in the field.

What is the annual expense of keeping up the army in general, and the pay of each particular grade? How are the soldiers fed, lodged, clothed, and paid? What is the moral character and discipline of the army? Is its courage of the active or passive kind?

How is the recruiting performed? What are the arms, accoutrements, and dress of the different kinds of troops; and what kind of horses have they?

What is there worthy of remark in their artillery, whether battering train, or field-pieces, &c.?

What is the kind of warfare usually adopted by the nation under examination; what is their treatment of prisoners?

Are there any strangers in the army; if so, are they indifferently of every country, or is there any preference or exclusion in this respect? What may be the number of foreigners in the army, and in what capacity are they usually employed? Are there any whole bodies of foreign troops; if so, how are they recruited, and is their organization different from that of the rest of the army? Is their pay the same as that of the natives, or is it greater or less? Have these foreign troops any particular privileges; and if so, what are they? Does there exist a good understanding between the foreign and native troops, or are there jealousies between them? What are the advantages or disadvantages resulting to the nation from the employment of foreign mercenary legions?

How are the troops disposed of in the country in time of peace? Are they employed on national works, or allowed to follow any private industry? Are they often assembled for exercises and reviews, where and when?

How are the army and navy departments organized? Is there anything remarkably advantageous or defective in their organization? If so, specify it.

What is the number and distribution of the arsenals in the country, and what do they present worthy of remark?

What are the military schools, their number and distribution, what is taught in them, what number of pupils are

there, what becomes of them, what is the expense of their establishment, by whom is the education paid for, and what is the advantage accruing to the country from these institutions?

Besides all the preceding details, the enquirer must notice whether or not the army is adequate to the defence of the country, and proportionate to its means of maintenance. Whether the soil, by its great fertility, admits the existence of a great number of idlers, who consume without reproducing, that the keep of the army be not a burthen to the country, or whether, on the contrary, the maintenance of the army be an oppressive charge upon industry; whether the social position of the soldier be such, that the citizens willingly enrol themselves, or such, that they can be made to enter the army only by compulsion? What encouragements and recompenses are offered for zealous services? Is the army so highly considered (which it always is in despotic countries,) that the nobility devote themselves in preference to the military career?

What is the general spirit of the military code and discipline of the country, and the authority of the superior officers?

If the army be composed only of a militia, who are the persons bound to enrol themselves, and who, if any, are exempted from military service? What are the terms of enrolment, and what duty is required in time of peace of the citizen soldier?

In a word, is the army what it should be, with regard to the nature and extent of the country, its population, its institutions, and its social state? if not, where is the anomaly, and how might it be corrected?

Navy.—The navy of a country should be considered in a manner similar to that we have pointed out for the army. Accordingly, the enquirer must ascertain what is the total number of vessels of war, and the number of each particular kind, the total number of sailors, marines, and guns; the kind of guns usually employed, and their weight of ball. Is there any thing particularly remarkable or advantageous in the form of the gun carriages or mode of tackling them; any thing remarkable in the construction of the vessels themselves, or any part of them? Observe the capstans, windlasses, anchors, chains, masts, cordage, sails, suspension of rudder, &c.

What fire ships, gun-boats, flotillas, war-steamers, &c., are there?

What is the usual way of coming into engagement, and fighting their ships?

What is the general spirit, bravery and ability of the commanders, the sailors, and marines? What is the discipline on board vessels of war? How are the men clothed, fed, and paid?

What is the annual cost of the naval department and the pay of the several grades? what are the regulations, encouragements, punishments, &c., and the mode of recruiting?

Influence of Political Position.—It now remains for us to say a word on the influence which the country under examination may have by reason of its wealth, and its particular relations with other countries; a kind of influence which greatly modifies its offensive and defensive resources. But as this subject will be separately treated in the next division, it is needless to speak of it here. At present it may suffice to observe that money is essential to war; and, that if it be true that, with arms we may procure gold, it is no less so, that it is impossible to maintain armies without money. As for political relations we may remark, that the immediate protection of a rich and powerful nation is a means of defence which sometimes renders every other unnecessary.

All that we have said on the subject of a country considered under a military point of view, has been in order to facilitate general observation. Nevertheless, we trust we have treated it in sufficient detail, to inspire that degree of interest which the intelligent traveller should take in it, and to be of practical utility. Many considerations are certainly wanting to complete the subject, but they cannot have place in a work like the present, and may be found in a multitude of books on military science, to the best of which we refer the reader.

DIVISION X.

SECTION I.

FOREIGN RELATIONS.

There exists between nations the same kind of mutual dependence as between individuals. We see the same reciprocal wants, the same envy, the same jealousy, the same oppression of the weak by the strong; the only difference is, that as nations act in powerful masses, and with means proportionate, their disputes or their friendships are followed by consequences influencing the misery or happiness of millions of individuals, the greater part of whom are generally utter strangers to the cause of the events by which they are affected. Hence the immense, the awful responsibility of those who govern; hence the great importance of political science; hence the gratitude and veneration which are inspired by the wisdom and virtues of a sovereign, and the maledictions pronounced against guilty ambition by its suffering victims.

We are not to treat here, of the origin of nations, nor of the succession of events by which the interests of many have become so blended, and which events are rapidly preparing the way for the collection of the whole human race into one great family, united by common wants, disunited by particular interests, and tacitly governed by a common law, the Rights of Nations.

We will take nations as they are, and in this state we say, that their interest, sometimes well, sometimes ill understood, is the ostensible reason of their conduct one towards the other: we say the ostensible reason, for history abounds

with examples of nations led on to war under false pretences, while the real cause was the individual interest of the sovereign, or the intrigues of his court.

It is to the interest of a nation to be happy at home and respected abroad. These two objects constitute, or ought to constitute, the foundation of all the foreign relations of states.

In order that a nation may enjoy all the happiness of which it is susceptible, it is essential that all those objects which are necessary to the business and comfort of life, should be as diffused as possible among the individuals which compose it. In order to this, nations are not content with enjoying the productions of their own industry, but seek those of foreign industry ; to obtain which, recourse must be had to conquest or to commercial relations.

It would be superfluous for us, in the present age, to insist on the advantages of commerce ; but, if we are agreed as to these advantages themselves, we are by no means unanimous in our opinions as to the best mode of securing them. There exists among all European nations a prohibitive system, which, by its generality, nullifies the object of its establishment, and tends to the maintenance of an egotism, false in principle, like every thing exclusive, and as injurious to the real interests of nations as private monopoly is to that of individuals.

The particular wants of nations modify the articles of their commercial treaties with each other ; these treaties of commerce are either contained in, or are supplemental to treaties of peace and amity ; for as in war the law of nations permits them to injure each other as much as possible, so in times of peace they are bound to help each other, as far as they can. But besides commercial treaties, and treaties of peace and amity, there are special offensive and defensive alliances. The parallel we have before drawn between nations and individuals still holds good here ; for injustice is common to both ; the strong oppresses the weak, who frequently can preserve their existence, only at the price of their independence. In this way small states maintain themselves ; they place themselves under the protection of the great, who guarantee their safety by a kind of feudal tenure.

The great powers themselves secure their mutual repose by treaties of peace and amity ; and here our parallel no longer holds. For when individuals violate their engagements, the injured party invokes the laws, and the tribunals

cause them to be executed. But when a great power violates the treaty it has concluded, there is no appeal but to arms; and the example of all times shows that treaties serve only to define the *forms* of amicable relations so long as this relation exists; but that they in no way assure the continuance of such friendship whenever it is the interest of either party to infract the treaty. The existence of great permanent armies in time of peace sufficiently testifies the insincerity of those who maintain them, or their want of confidence in the sincerity of others: and all governments seem to act upon the literal meaning of the ironical councils of Machiavel.

Several powers sometimes unite their general interests, or their interest in some particular object, by a federal treaty. There are also treaties or promises of neutrality, &c.

Thus, then, the foreign relations of states differ in their objects; sometimes they are purely commercial; sometimes these become treaties of offensive and defensive alliance, or of neutrality; and sometimes different objects are combined in the same treaty; or distinct treaties are entered into by the same powers for distinct objects.

Foreign relations differ also by their stipulated duration, which is sometimes for a long or short time, sometimes indefinite and called perpetual. They differ also as regards the number of the contracting parties. When there are several the alliance becomes a confederation.

Powers that are on friendly footing with each other, have avowed servants who, under the denomination of Nuncios, Ambassadors, Ministers, *Charges d'Affaires*, Consuls, &c., reside in the several states reciprocally, to maintain the strict execution of the existing treaties; to keep up a good understanding, and to watch with jealous eye the movements and measures of the parties.

Let us now pass on to the more detailed observations to be made on the subject of foreign relations.

What is the natural political position, in which the country stands as regards other countries? Does this position depend upon their relative geographical situation, their respective extent, their productions, their origin, their religion, their civilization, their form of government, their ambition, their interest, their respective strength or weakness, their similarity or contrariety of disposition, or their morals and manners, &c.? The natural political position may be one of friendship or enmity; which of the two is it?

Are the existing treaties which bind the country under consideration, to other countries, founded on the natural position in which they stand towards each other, or are they calculated to counteract the effects of such natural position? In their commercial treaties are the advantages reciprocal, or greater for one of the contracting parties than for the other, if so, which is favoured, and how? What are the most remarkable articles of such treaties?

In all cases, what are the circumstances which have brought about the existing treaties; at what time, where, and by whom were they signed; by what are they guaranteed; what advantages have accrued from them, or are expected, or what faults have been committed? Old treaties no longer in force, belong to the history of the country, and need only be considered in as much as their execution or infraction may have led to, or modified existing treaties.

What ambassadors, or other diplomatic agents does the country maintain at foreign courts? and from what powers does she receive such?

Is the country reckoned among the great powers, among those of secondary rank, or among small states? Does it receive or pay any subsidies?

Of what weight is the country in the balance of political power; does it owe its importance to its wealth, its armies, or to the natural relationship in which it stands towards other countries?

How is the department of foreign affairs organized; what attention is paid by the government to the political instruction of those, who are destined for the diplomatic career?

In what spirit and upon what principles are the political affairs of the nation conducted; are its political relations founded on egotism or liberality? Is the nation remarkable for its faithful observance of treaties, or the reverse?

Does there exist between the departments of foreign affairs and that of the interior, that harmony which can alone secure prosperity at home and influence abroad?

Besides these observations, the traveller should not fail to notice every thing worthy of attention on so important a subject as the political position of the country; remembering ever, that the main object is to arrive at a know-

ledge of the advantages and disadvantages of the political system of the country; the influence of this system on its general prosperity, and the effects of the system on other countries.

A judicious observer, possessed of knowledge and sagacity, may add to his narrative whatever may appear to him likely to increase the advantages of the political system of the country.

SECTION II.

COLONIES.

By the word *Colony*, is generally understood a union of families established out of their native country, or sometimes in their own country, but at a distance from their birth-place; the name is also applied to the territory so occupied.

Different circumstances lead to colonization: sometimes it is caused by a superabundant population; sometimes the hope of deriving a greater advantage from one's industry or commerce; sometimes religious, civil, or political persecution; and sometimes people are lured away to mining countries, by the prospect of realizing great wealth. These several causes, exercise of themselves great influence on the prosperity of colonies, on their stability, on their fundamental laws, and political conduct.

When a superabundant population is the cause of emigration, the emigrants are generally of the poorer class; they carry with them their simple manners, their frugal habits and their industry. Whatever may be their opinions of their religion, existence is their first care; they unite as brothers, urged by the same fate towards the same object. If they have made choice of a virgin territory, they give themselves laws as simple as their own conceptions.

They will be framed in a republican spirit, and the society will prosper till too great an inequality of fortune, or other circumstance, introduces into it luxury and ambition, or till some extraneous event shall disturb its quiet.

Such a colony, in its infancy, has no foreign relations, but such as are necessary to the security of its existence: later, when their wealth increases, they think of commerce. If the country where the emigrants are established be already inhabited and governed by laws, the colonists are in general subjected, wholly or in part, to such existing laws; a circumstance which naturally produces a considerable modification in their position.

If commercial advantages be the chief object of emigration, the colonists are generally families in comparatively easy circumstances and possessing a certain capital. They go in search of increased wealth, and usually lay the foundation of their future speculations in the mother country before their departure. When they have obtained a charter of possession of the new territory, they subsequently admit into it, such settlers only as cannot interfere with their interests: their fortunes made, these colonists return to their mother country, and new adventurers replace them. Colonies of this kind do not greatly increase their population, but others of the same nature may be established in their neighbourhood; then jealousies spring up, by which they are mutually injured, and, unless they unite their interests, they exist amid continual alarm and discord, and sometimes go to war.

Colonies of planters are generally established in hot and unhealthy climates; for it is in such principally, that those plants grow, whose produce is the object of their speculations. The colonists, therefore, either administer their affairs by agents, or remain in the colony, as do these agents themselves, only till they have realized a fortune.

Mining speculations, if successful, are more likely to be followed by the permanent settlement of the colonists, because when the precious metals are the objects of acquisition, avarice, which increases in proportion as it is fed, will seldom allow the possessors of mines, to confide their treasures to the superintendence of agents.

When religious, civil, or political persecutions oblige families to leave their native country, it is a particular party that expatriates. The several families which compose it, have the same religion, or the same civil or political

principles. The party is composed of men of all classes; rich and poor, start together; the learned and the ignorant, the industrious and the idle.

Such colonists bring along with them to their new country, their passions, their habits and their prejudices; the more powerful continue to command, the weaker to obey; but a common misfortune unites them, the former are less despotic, the latter less subservient. Their laws will in the main be framed upon those of the mother country, with the exception of those clauses which have led to the evils that caused their emigration; in place of which, such others will be substituted as shall secure the society from similar misfortunes; and it is in the institutions conceived with this view, that the greatest obstacle exists against the admission of new comers of another religion, or professing other principles. The laws will be exclusive, perhaps even intolerant.

There is a great difference in the conduct of colonies, according as they result from religious, civil, or political persecutions. If the religion that is persecuted, is itself intolerant, and has merely succumbed for want of strength, the same intolerance will characterize its conduct towards strangers. If, on the contrary, it be a tolerant religion which is persecuted, it will be still tolerant in its principles, but will be wary and distrustful.

An aristocracy driven out by the people, tired at length with their tyranny, their exactions and their caprice, will difficultly divest themselves of their haughty bearing; they will take it along with them, and testify one towards the other, that arrogance which they can no longer exercise upon submissive inferiors. Hence discord will soon be introduced, and the society thus composed must soon be broken up. But men who fly from tyranny and oppression will themselves be moderate in their principles and peaceful in their habits; they will form a society of friends. Enemies to arbitrary rule, they will tolerate such authority only as is necessary for the maintenance of order, and this authority will be elective.

When the inhabitants of a conquered country, unable to live under the laws of the conqueror, seek out a new country, they will make no changes in the laws they have loved, and for which they have sacrificed so much; such colonists carry along with them a determined independence of spirit, great energy of character, and a deadly hate towards the

usurpers of their native soil; their manners, their customs, their laws, every thing will be as it was, with the exception of such modifications as the climate and their new situation render necessary.

A colony founded for the working of mines being generally composed, for the greater part, of individuals thirsting for wealth which they hope to obtain with little trouble, will have a marked character of haughtiness and egotism. These colonists, given up to ungovernable passions, generally exercise unrelenting tyranny over their subordinates, whilst they themselves, surrounded by their heaps of gold, live in anarchy and disorder.

Of all colonies those founded for the working of mines are the most ruinous to the country which sends, and to the country which receives them. Who does not see the truth of this in the example of Spain and Portugal, and the so long miserable provinces of Mexico and Peru!

A colony may either take possession of new land, or seek refuge in the territory of some foreign power, whose interest it is to receive it. In the former case, it will assume one or other of the characters we have specified; or perhaps the colony will be bound to recognise its dependence on the mother country. Indeed when it does not, it is no longer in strict parlance a colony. This dependence is, however, always a restraint, which is thrown off as soon as possible.

A country hardly yet civilized, or but thinly peopled, often derives an advantage in receiving colonies from countries that are more civilized and too thickly peopled. In such case, it is customary, in order to encourage strangers to bring into the country their fortune, their industry, and their knowledge, to grant them particular privileges and immunities beyond what the natives enjoy. Colonies formed in this way, will be in greater or less number, and more or less populous, as the country shall offer greater or less advantages in the form of its government, its laws, its manners, the fertility of its soil, the mildness of its climate, its commercial relations, &c.

By far the greater number of colonies, however, are the result of forced emigrations. The discontented, the unfortunate, the persecuted, the imprudent, fly from the theatre of their sufferings to seek a better fate far from their native country; each individual, according to his principles, his religion, his taste, directs his steps towards the spot he

thinks most likely to afford him the happiness he anticipates. Many individuals expatriate themselves, and disperse over different countries without forming colonies, but they tend to increase the population of such as are already formed.

Penal colonies are such as are established for the double purpose of sending bad characters out of the mother country, and peopling and settling new countries. Composed as are such colonies, of an unprincipled multitude of both sexes, they require to be governed with great firmness. The chief object of their government should be, less to punish for faults committed than to correct vicious habits and inspire principles of virtue, of order, and industry ; so as to form a community whose labours may be useful to itself, and beneficial to the mother country.

Having thus pointed out briefly the various cases of colonization, it is for the intelligent traveller to glean, from what we have said, the kind of observation he should make regarding colonies.

Thus he will ascertain what was the origin of the colony and its object, when and by whom founded, its situation, extent, and population, increasing, decreasing, or stationary ; its geographical and physical features ; its internal laws and government ; its regulations regarding the admission of new settlers ; its relations with the mother country and with other states. Is it advantageous or the reverse to the mother country, and in what do the advantages or disadvantages consist ? When a colony is large, it may be regarded as a little independent nation and examined as such ; so that all the observations detailed in the several Chapters of the present work are, more or less, applicable to colonies.

Every thing peculiar to them, however as colonies, such as their charter, &c., should be carefully noted ; and on no account should the traveller omit to notice the general advantages or disadvantages resulting from the mode in which the settlement is conducted. Of late years new principles for the formation and management of colonies, and the distribution of land, have been put in practice with great benefit ; but like in every thing else, the principle, though good, has been abused, to the injury of several who expected to profit by it. Thus, the sale of colonial land, intended for the benefit of the colonist, has become a jobbing concern, carried on to an enormous amount, &c.

Finally—what benefits have accrued from the colony to the country which sent it, to the country which received it, and to the colonists themselves; has it been favourable, or is it likely to be favourable to the purposes of civilization, by spreading throughout a barbarous country, the arts, the sciences, the industry of Europe, and the Christian religion?

DIVISION XI.

INSTRUMENTS AND OPERATIONS.

SECTION I.

INSTRUMENTS.

The traveller who would make interesting and useful observations in Physical Geography and Meteorology, must be provided with certain instruments. These may be more or less numerous, according to the extent of the observations he purposes to make, and the facilities which he may have for transporting a certain quantity of baggage. Much will also depend upon the nature of the country he intends travelling over. In any case, however, we could not enter here into a detailed description of all the philosophical instruments which a traveller might wish to take with him ; we shall, therefore, confine ourselves to giving a list of the more useful instruments for observations connected with Physical Geography and Meteorology, distinguishing by an asterisk (*), those that are absolutely essential, and to offering a few words explanatory of the nature of several of them.

LIST OF INSTRUMENTS.

* Sextant and Artificial Horizon.
* Prismatic Compass.
* Pocket Compass.
* Pocket Chronometer.
* Portable, or Mountain Barometers.
* Ordinary Thermometers.
* Maxima and Minima Thermometer.
* Barometric, or Boiling-point Thermometer.

Thermometer for temperature of Soil and Water at great depths.
Thermometer for Solar Radiation, Actinometer.
Thermometer for Terrestrial Radiation.
* Hygrometer.
* Clinometer.
Instrument for bringing up Water from a depth.
Hydrometer.
Diaphanometer.
Log and Line.
Rain Guage.
Atmometer.
Wind Guage.
Drosometer.
Electrometer.
Cyanometer.
Photometer.
Instrument for the direction of Earthquakes.
Eudiometer.
Magnetical Instruments.
Telescope.
Microscope.
Docimastic Apparatus.
Geological Hammers.
Measuring Tape, Lead and Long Graduated Line.
Mathematical Instruments, Colours, &c., &c.

Of the four first of these instruments we shall say nothing, presuming they are well understood by those who intend using them. The only precaution we shall recommend is, that they be well chosen; and here we would remind the traveller, once for all, that no expense should be spared by him to procure the best instruments that are made. It is better to have but few, and those such as may be depended upon, rather than a great number of such as are badly made, and ill-conditioned.

BAROMETER.

This is an essential instrument both for meteorological observations and for the measurement of heights. Unfortunately, it is an instrument extremely likely to get broken, and hence various constructions have been imagined to render it portable and secure. We believe that constructed by Mr. Newman, of Regent Street, to be the best for travellers; it is thus described by the maker:—

This instrument differs in its construction from the Engle-

field Barometer, in the adoption of a double iron cistern with a solid bottom, in lieu of the wooden cistern and leather bag; and a few instructions for its use will be necessary, as the method of rendering it portable differs also. In the old instrument a screw at the bottom, compresses the whole of the mercury in the cistern, as well as in the tube, frequently forcing it through the pores of the wood, and rendering the barometer useless: in the new instrument this defect has been remedied; and with great simplicity the mercury is secured for travelling, or set at liberty for use, by holding the instrument with the cistern end upwards, and moving the upper part from left to right, making the word *portable* engraved on the cistern, coincide with the *stop;* or by a contrary motion, bringing the words *not portable* opposite the *stop* when the instrument is intended for use.

The instrument also varies from the common barometer, being a *standard* of itself, the actual distance between the height of the mercury in the tube and the level in the cistern, having been measured without a reference to any other barometer; so that by applying the corrections as hereafter mentioned, you obtain the actual height of the column. Care should be taken to hold the instrument with the cistern end upwards, when it is intended to be made portable for travelling, otherwise the mercury will be left at liberty, which will endanger the instrument. And it is important, when the barometer is moved or carried, that it be retained either in a horizontal position, or with the cistern end extremely raised; this prevents the oscillation of the mercury in the tube.

To observe with the instrument it is most advisable to suspend it, by the ring on the top, from some fixed and steady projection, in a perpendicular position; but, if such a situation do not offer, it may be suspended with the hand, letting the lower end rest lightly on the ground, and then, by kneeling on one knee, the index may be brought to a level with the surface of the mercury, being at first moved by the small projecting piece on the edge to nearly its correct situation; and finally adjusted by means of the tangent screw on the top. Great care should be taken in placing the index accurately, with respect to the surface of the mercury, and it is advisable to use a magnifier, when the situation will allow.

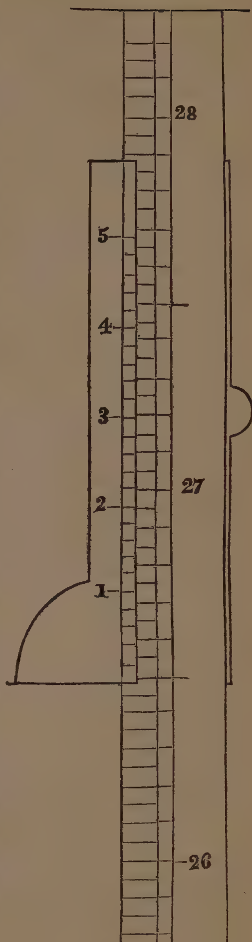
When the index has been made to coincide accurately with the surface of the mercury, the inches are of course

read off upon the numbered scale; the tenths are read off upon those divisions, which extend from the first to the third perpendicular line, counting upwards from the top of the inch, and reckoning as many tenths as occur short of the index: if any portion remain between this tenth and the index, it may be estimated in hundredths; this space will include one of the half-tenth graduations, if the hundredths be more than five in number; but a half-tenth will not be included, if they be less than five in number; the half tenth in fact being equal to five hundredths. For the estimation of the hundredth, pass the eye up the graduations of the vernier, looking for that *numbered* degree which coincides or nearest coincides, with any graduation upon the large scale, and such degree will express the number of hundredths upon the vernier, thus, if the line, marked 3, coincide, it indicates three hundredths, and this is the correct expression if there be no half-tenth as before-mentioned; but, if there be a half-tenth, then the five hundredths of which it is composed, are to be added to the three in the vernier, making eight hundredths, which are to be added to the inches and tenths before observed and noted.

By means of the divisions on the vernier, each of the hundredths is divided into five parts, or five hundredths, and are here read off; thus it may happen that the coincidence of a line on the vernier, with a line on the scale, does not take place with any of those numbered on the vernier, but with one of the smaller unnumbered divisions; it may happen for instance, with a line between the third and fourth hundredth on the vernier, and then it is evident that three hundredths are too little, and four hundredths too much; in this case, read upwards from the lowest hundredth, to the line which coincides, and it will express the five hundredths; each of which if written as decimals, will count as two thousandths.

As an instance will render this description (necessarily complicated) easy and clear, let the diagram represent the position of the vernier, when the index is finally adjusted, the 26 inches are at once read off; above that and beneath the index occur four tenths, making 26·4, there is also a half tenth or five hundredths, making 26·45; then for the smaller portion still remaining beneath the index, by looking to the vernier, it is seen that the lines which coincide, are between the second and third hundredths, two

hundredths therefore are to be added, making 26·47, as the line, on the vernier, which coincides, is the second above the second hundredth, it indicates two five hundredths, or four thousandths, which added to the previous figures, 26·474, is the height of the index, and consequently the height of the mercury. The estimation in thousandths is not deceptive as to accuracy, inasmuch as it is easy, by a lens, to ascertain whether the lines actually coincide, or whether the two neighbouring degrees or lines are not equally near to coincide.



When an observation is made, the height, as read off requires correction, before it expresses the true height. Suppose the instrument in a chamber, acting as a standard barometer, or as indicative of the variations of the atmosphere, and that an observation has been made; if it coincide with the neutral point, as marked upon the instrument, then the reading by the scale and vernier expresses the true height of the mercury, for that height has been actually measured from the surface of the mercury in the cistern to the surface of the column in the tube, as before stated.

But in most cases the mercury will stand either above or below the neutral point; if above, a portion of the mercury, which has entered the tube, must have left the cistern, and consequently have altered and lowered the surface there; or if below, a quantity of mercury must have left the tube

and entering the cistern, have raised the level of the mercury to it.

For the corrections of observations thus circumstanced, the area of the mercury in the cistern and that in the tube, have been experimentally ascertained, and are expressed by the number marked on the instrument, and called capacities: thus capacity 1-50 indicates that the surface of the mercury in the cistern, is fifty times that in the tube; hence it is evident, that for every inch of elevation of the mercury in the tube, that in the cistern will be depressed 1-50 of an inch: for this, correction is made in the following manner:—When the mercury in the tube is above the neutral point, the difference between it and the neutral point is to be divided by the capacities, and the quotient *added* to the observed height, the result being the true height; or if the mercury, at the time of observation, is below the neutral point, the difference of the two is to be divided by the capacities as before, and the quotient is to be *subtracted* for the observed height, the result is the true height. Thus suppose the capacity 1-50 the neutral point 30 inches, and the observed height 30·500, the difference between 30 and 30·5, is 0·5 inches, which divided by 50 gives ·010 inches, and this added to the observed height, =30·510 the true height; or if the observed height be 29 inches, then the difference, 1 inch divided by 50 gives ·020, which subtracted from the observed height, gives 28·980 inches, as the true height.

There is still another correction required before the height of the column is accurately ascertained; this is for the capillary action of the tube, the effect of which, is constantly to depress the mercury in the tube by a certain quantity. This effect is experimentally ascertained during the construction, and marked upon the instrument, the quantity is always to be added to the height, previously corrected as above.

When the barometer is used in the measurement of heights, as above mentioned, two observations, a lower and an upper one, are required, and the difference is one datum, from which the height is determined; this difference may easily be ascertained, by taking the difference between the observed heights, dividing it by the capacity and adding the quotient to it, which will give the true difference, in this case no notice need be taken of the neutral point. Thus let two observations be made on a mountain, 30·50 and 29·00, which

differ from each other by 1·50 inches, this divided by 50, gives 0·03, which added to it = 1·53 the true difference.

It is necessary in taking the height of any place, to have two barometers; these should be compared at the lowest station, where one should be left, and a time stated, or signal given, when the simultaneous observations are to be made; the object of the two observations is to ascertain whether the barometer has either risen or fallen since the first observation: the change, if it occurs, will be observed at the lower station, and must be noted.

These barometers have been accused of letting the mercury escape, but Mr. Newman has assured the writer that in future such a mode of adjusting the reservoir to the tube shall be adopted as effectually to prevent this defect.

Portable however as are Newman's barometers, and perfectly secured as they seem to be, still great caution must be employed in carrying them. The cistern must always be uppermost in transporting the instrument, and the traveller should confide it to no one, but carry it strapped across his own back; remembering that, if broken, a fresh tube is not readily supplied and properly filled.

THERMOMETERS.

Of the different descriptions of thermometers that are made, some are essentially necessary to the traveller; the others he need only provide himself with according as he means to devote himself to those particular physical researches for which they are exclusively destined.

The thermometers which every traveller should have with him are of two kinds. 1. Such as are intended for habitual use on ordinary occasions. 2. Such as are destined to register the maximum and minimum temperatures in the absence of the observer.

The graduation of the scales of these two kinds of thermometers, and indeed of all those which the traveller may carry with him, should be on the same principle, whether it be Fahrenheit's, Reamur's, or that of Celsius, otherwise called the Centesimal or Centigrade: we ourselves recommend the latter.

Ordinary Thermometers.—The thermometers for ordinary purposes should be mercurial, as they are preferable in all cases except where extreme colds are to be measured, when alcoholic thermometers are indispensable. Travellers

into northern regions, and those whose excursions extend into the limits of perpetual congelation, should be provided with alcoholic rather than with mercurial thermometers.

The mounting or scale must be of brass, silvered on the graduated side ; ivory and wood are hygrometric, they warp and bend, and in so doing break the tubes.

The degrees on the scale must be traced across behind the tube so as to be seen through it.

The bulb should be cylindrical, as projecting less and being more sensible than when the form is spherical.

The instrument must be of such length as to be conveniently portable, while at the same time the scale shall embrace a range of from—40° to+100° Cent. distinctly divided into half degrees.

The absolute dimensions and construction of an instrument which shall satisfy the above conditions, may be thus stated.—Length of the brass scale or mounting 12 inches ; breadth 5-eighths of an inch ; thickness 1-twelfth of an inch. Length of the tube, including the bulb, 11¼ inches, mounted so as to extend at bottom to within ¼ of an inch of the lower end of the mounting, and at the top to within ½ an inch of the upper end ; abstracting from this length say 1½ inch from the bottom of the bulb to the lowest mark, or—40° and 1 inch from the + 100° to the top of the tube, there will remain 8¾ inches or 70 eighths of an inch for the whole range of the scale, or 140 degrees, so that the degrees will be each 1-sixteenth of an inch, the half of which is easily distinguished. The proportion of the diameter of the bore of the tube and the size of the bulb, must accord with these general dimensions of the instrument and bear as perfect a relation to each other as the ability of a practised artist can make them. The bulb must no where touch the metal mounting, and there should be no guard over the bulb. For suspension, a circular hole of sufficient size must be made in the upper end of the mounting. The instrument should pack into a case made of two pieces of seasoned wood, the lower one being cut to receive it exactly, after being lined with cloth or velvet, and the upper portion or lid being wadded, the two being joined by strong hinges and shut by means of hooks.

The traveller should be provided with at least two such thermometers,* not merely because one may get broken, but

* These thermometers are constructed by, and may be had of, Mr. Newman, 122, Regent Street.

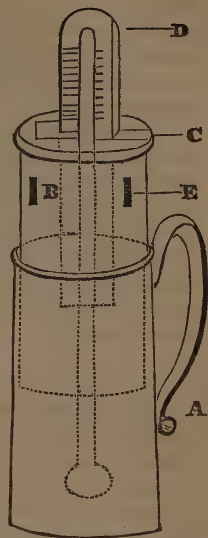
because it is frequently necessary to make simultaneous observations in two different places. We say two thermometers are indispensable ; if the traveller can take more, so much the better.

Maxima and Minima Thermometers.—The second kind of thermometer we have mentioned, is the self-registering *maxima* and *minima* thermometer, the object of which is to point out, in the absence of the observer, the extremes of heat and cold ; it is a very useful instrument, and no traveller should be without it. The one we recommend in preference to every other is Rutherford's, on account of its great simplicity and easy adjustment for each fresh observation. The two thermometers, that is the one for registering the *maxima* and that for the *minima*, should be on separate mountings ; which may either be of wood or metal. We ourselves give the preference to metallic scales, provided they are narrow and present as small a mass of metal as is consistent with solidity and a distinct graduation.

Besides the above-mentioned thermometers, which we consider indispensable, there are others, constructed for particular purposes ;—we shall here mention one or two.

Barometric or Boiling-Point Thermometers.—The object of these thermometers is to ascertain approximately the heights of places by the temperature at which water boils. he range of these thermometers is from 180 to 215 Farht. (we, however, recommend the centigrade scale), the latter being somewhat above the temperature at which water boils at the level of the sea under ordinary circumstances, and the former the temperature at which it would boil at an elevation of between 17,000 and 18,000 feet. The graduation should be to half degrees at least ; but it were still better to have each degree divided into fifths, the half of which, correctly perceptible, will, of course, be-one tenth of a degree.

These thermometers are accompanied by a small tin or copper pot into which they are adjusted. The complete instrument will, however, be better understood by inspection of the figure.



A. Common tin pot, 9 inches high, by 2 in diameter. B. a sliding tube of tin, moved up and down in the pot; the head of the tube is closed, but has a slit in it C, to admit of the thermometer passing through a collar of cork, which shuts up the slit when the thermometer is placed.

D. Thermometer with so much of the scale left only as may be desirable.

E. Holes for the escape of steam.

For the mode of using this instrument, see OPERATIONS.

These thermometers are strongly recommended by Colonel Sykes, who has employed them for a great many years in ascertaining heights where strict accuracy is not required, or the means of obtaining it are wanting; they have certainly the advantages, which barometers have not, of being very portable.

Thermometers for ascertaining the Temperature of the Soil, or of Water at great Depths.—The temperature of the soil and that of water at great depths may be obtained in different ways, as described in the section OPERATIONS; but where particular thermometers, or ordinary thermometers with particular adjustments, are employed, their chief peculiarity consists in having their bulbs enveloped with a greater or less thickness of some bad conductor of heat; so that the temperature acquired by the instrument may be in no danger of changing, in bringing it up through strata of air or water of different temperatures. Tow, cotton, wool, down, folds of linen, or of cotton, or of cloth; or sawdust, or pounded charcoal or tallow will answer the purpose, and the choice among these will depend upon circumstances and require a corresponding arrangement of the instrument.

Adjustments for applying the bad conducting substances to the ordinary thermometers may be easily contrived upon the spot; or they may be properly constructed according to directions by any intelligent instrument maker.

Thermometer for Solar Radiation.—The Actinometer is the most perfect instrument yet invented for measuring the solar radiation, but it is bulky and expensive. A much more portable, and considerably less expensive instrument may be

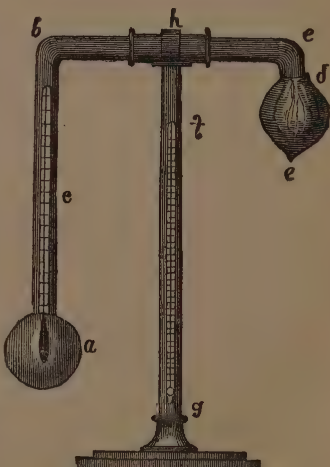
employed for observing the solar radiation; it is simply a maximum register thermometer, with its bulb uniformly blackened with lamp black and varnish, and the graduation marked upon the glass stem. For the mode of using it, see OPERATIONS.

Thermometer for Terrestrial Radiation.—The instrument hitherto invented for this purpose consists of a parabolic metallic mirror, being of silver plated copper or planished tin plate or zinc, six inches in diameter and two inches deep. In the focus of this mirror is placed the bulb of a register spirit thermometer, graduated on the glass stem, which stem passes through sockets in the sides of the mirror, where it is accurately adjusted by corks. To use the instrument, see OPERATIONS.

HYGROMETERS.

Hygrometers are of various kinds; of these we recommend but two, either of which the traveller can take at his choice. The first and most complete of these is unquestionably—

Daniell's, or the Dew-Point Hygrometer.—This instrument consists of a tube twice bent, having a bulb at each extremity. This tube is supported by the middle on an upright stem, so that it assumes somewhat the form of a T as seen in the figure.



The ball *a* is of black glass about one and a quarter inch in diameter, and is connected with a ball *d* of the same size, by a bent tube one-eighth of an inch in diameter. A portion of sulphuric æther, sufficient to fill three-fourths of the ball *a* is introduced; a small mercurial thermometer, with a pyriform bulb, is fixed in the limb *a*, *b*, the atmospheric air is expelled as completely as possible, and the whole is sealed at *e*. The ball *d* is covered with muslin; the whole is supported on a brass stand *f*, *g*, on which is another

delicate mercurial thermometer. The tube can be removed from the spring tube *h*; and the whole, together with a phial of æther, packed neatly in a box, that goes easily into the pocket. For the manner of using the instrument, see OPERATIONS.

Leslie's or the Thermometric, or Wet Bulb Hygrometer.—This is a differential thermometer, in which the ball containing the supply of coloured liquor is coated with several folds of tissue paper, and kept moist with distilled water. The two bulbs or balls must be of the same height, the naked ball blown of coloured glass, and the coated ball covered with thin silk of a paler shade of the same colour. The covered ball is kept moist by the capillary action of a few fibres of floss silk, the extremities of which at one end are spread over the covered ball, while the other ends and some length of the fibres plunge into a bottle of water. This should, if possible, be distilled water, but as this is not always to be had, water that has been boiled, then allowed to cool and filtered, may be used. In proportion as the covered bulb becomes cooled by evaporation, the coloured liquor in the tube, which is strong sulphuric acid tinged with carmine, descends the scale of the instrument, the O point of which is complete humidity. Mr. Leslie estimates that for each degree of his hygrometer, air, at the temperature of the moist ball, will take up moisture equal to the sixteen thousandth part of its weight. This hygrometer continues to act though the surface of the coated ball be covered with ice, but in this case the depression is greater by one-seventh, so that the value of the degrees, in this case, must be augmented by that quantity, to make them correspond to an absorption of moisture equal to one-seventeen-thousandth part of the weight of the air.

It must be remarked that although the indications of the wet bulb hygrometer may be observed at once, without difficulty, while it requires some practice to observe the dew point with Mr. Daniell's instrument, still the former furnishes us only with the temperature of evaporation, (each degree of the instrument corresponding to one-tenth of a degree of the centigrade thermometer,) while the latter furnishes all the data requisite for solving all the problems of hygrometry.

CLINOMETER.

This instrument is used for observing the dip and strike of strata; it has been made in various ways; that recommended by Sir H. de la Beche and figured in his book on "How to observe, Geology," is very simple and effective, but not very portable from its form. There is one in the form of a sector, with a spirit level and graduated arc, and with a small compass attached, which is very portable. The traveller will take such as he prefers, but we recommend his taking one of some kind or other.

INSTRUMENT FOR BRINGING UP WATER FROM CONSIDERABLE DEPTHS.

Various instruments have been contrived for bringing up water from great depths, but all, more or less imperfect: the last, we believe, is that of Mr. Daubeny, a very ingenious instrument, but as its inventor himself admits, it does not necessarily indicate the whole quantity of air which the water drawn up contained, a part of which is disengaged as the pressure becomes less in the ascent. But this is not the only, nor do we consider it the greatest defect of this instrument. It does not maintain the water at the precise temperature it had at the place whence it was taken, nor does it even admit of taking the temperature of the water as soon as it is drawn up. This imperfection is common to all these instruments.

The objects for which it is desirable to draw water up from a depth are the following:—

1. To ascertain its specific gravity.
2. To ascertain its temperature.
3. To examine its degree of saltness, if taken up in the sea, or in salt lakes.
4. To ascertain the kind and quantity of the detritus held in suspension at a given depth, compared to what is mixed with the water near the surface, &c.
5. To ascertain the quantity and quality of the air, or other gaseous fluid, which the water at great depths may contain.

Now, supposing the water drawn up from any depth, by any of the instruments invented, to be perfectly free from any

admixture with the water of the upper strata through which the instrument passes, then all the objects specified may be effected except the 2nd and 5th, for the last of which no instrument, unless it be Mr. Biot's, has yet been contrived, as even Mr. Daubeny's allows a portion of the air or gas to escape. As for the 2nd, we have not seen any instrument in which the water will retain its temperature, or even admit of its temperature being instantly taken when drawn up; and it is evident that if any time be lost, or the water be emptied into another vessel, the temperature will be still further changed. A perfect instrument is therefore still a desideratum. But even if the existing instruments were perfect, their bulk and weight render them quite unfit for forming part of an ordinary traveller's baggage.

The instrument therefore which we recommend is simply a cylinder of brass, three inches in diameter and nine inches in height, having at the bottom a valve opening inwards; the bottom of the cylinder should be heavily lested with lead, and its valve must be made to take off at pleasure so as to be able at any time, to examine and repair the valve, which should shut very close. At the top of the cylinder there is a valve opening outwards which remains open while the instrument is descending, but which the first smart jerk in drawing up closes. A spring catch still further keeps the valve shut so as to be in no danger of again opening, though the cord be accidentally slackened in drawing up the instrument. By this arrangement the water in the cylinder can never be mixed with any other. A brass loop handle is fixed to the upper part of the cylinder by pivots, so that when brought up, it falls to the side of the instrument leaving the top without incumbrance. To this handle the rope, by which the instrument is let down and drawn up, is fixed, and a similar brass hoop being fixed at the bottom of the instrument admits of attaching to it such additional weight as may be necessary to sink it, (this may be stones tied in a bag or cloth, or anything most convenient.)

In order to use the instrument, first see that it be quite clean and that the valves shut close, then fasten, if it be deemed necessary, the additional weights to the bottom; next tie the measured rope firmly to the instrument, let it down, and when it has attained the proper depth, hold it there a few minutes that it may take the temperature of the medium; when it is supposed to have done so, pull up by a pretty smart jerk at first, to shut the valve, and haul up quickly but

steadily. Open the catch and valve and put in a thermometer to ascertain the temperature, which must be immediately recorded. The water may then be put into another vessel in order to ascertain its specific gravity, its degree of saltness, &c.

When taking the specific gravity the temperature must be again noted, as it will by this time have changed.

It will be necessary also to note the time occupied in drawing up the instrument.

HYDROMETER.

There have been various instruments under the names of Hydrometer and Areometer for measuring the comparative densities of water and other fluids. The simplest of them all is a hollow pear-shaped glass or thin metal bulb bearing a graduated tube, and so ballasted as to remain perpendicular when plunged into the water. Upon immersing this instrument into fluids of different densities, it stands in them at different heights, indicated by the graduation on the tube, and thus the specific gravity of the fluid is at once indicated; such an instrument however answers no other purpose than the one just mentioned; but there is a form of the instrument which constitutes it also a hydrostatic balance, by which the specific gravity of solids, as well as fluids, may be ascertained; it is known as Nicholson's Hydrometer. This instrument may be had at any of the opticians, and printed directions for its use generally accompany it, and sometimes also, tables of the corrections for temperature.

A very simple contrivance for taking the specific gravity of water, consists of a set of small glass bubbles of different specific gravities; these are numbered and their specific gravities known. On throwing them successively or at once into the liquid to be tried, those whose specific gravity is greater than that of water, sink, those that are lighter, float, and the one which is of the same gravity as the fluid, remains suspended in it.

DIAPHANOMETER.

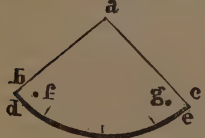
The very simple instrument, if indeed it even deserves to be called an instrument, to which we give the name of a *diaphanometer*, as destined to measure the transparency of

masses of water, is a small hollow sphere of copper of two inches diameter, well plated and polished. This ball has a small ring screwed in and soldered to it, by means of which ring and a strong twine, it may be attached to the lead of a lead-line or other weight let down. The length of the twine, exactly measured from the ball to the place where it is attached to the lead, being one foot. The ball being light has a tendency to rise to the surface, this is checked by the twine. In still water, the ball will remain suspended at a foot from the point where it is attached, in running water, it will play about. It is evident from the spherical form, that in whatever position it may lie, there will be a point which will reflect the light to the eye of the observer, which would frequently not be the case in using a flat surface or disc. We have ourselves, for experiments on the transparency of water, used a tin sphere of four inches; but a tin ball is neither sufficiently bright nor of sufficiently smooth surface, besides it is too large to be conveniently carried, and in time it rusts, from all which objections the plated two inch copper ball is free. The ball should be wiped dry after being used, and kept in a leather lined case.

LOG AND LINE.

Every one who has been at sea must have seen the log, but for those who may not have minutely examined this simple instrument for measuring a vessel's rate of going we shall here describe it in detail.

It consists of two parts, the log itself and the log line. The log is a piece of wood whose form is the quadrant of a circle, as in the figure. The radius *a b* or *a c* being about six inches; the thickness 3 lines. To the curved part is fixed by screws, a slip of lead *d e*, in order that, when the instrument is in the water it may remain steady, and the greater part immersed with the angle upwards. Two



small holes are made at the angles formed by the radii and the arc, as at *f* and *g*; a piece of line about 3 feet long, having a knot at one end, is passed through one of the holes, say *f*, the knot preventing it from coming right through; at the other extremity is fixed a wooden pin, which, when the instrument is set, is inserted, but not too tightly, into the other

hole *g*. To this line, and at very little from the middle of it, on the side towards the pin, the log line is fastened. The reason for not bending on the log line exactly in the centre will presently appear.

The log-line is divided into distances called knots, which are counted from a mark (72 *or* 90 *feet*) 12 or 15 fathoms, from the log. The length of line between knot and knot must bear the same proportion to a nautical mile that the sand glass used does to an hour. Thus if the glass be one of 30 seconds, the length of a knot must be 50 feet 11 inches that length being to a nautical mile, or 6110 feet, what 30 seconds are to the hour, viz. the 120th part; but as the friction of the reel and of the log-line through the hand, or a little inattention in letting it out quick enough, may occasion a small error, it is usual to allow 50 feet only for the length of a knot, which is divided into 10 fathoms of 5 feet each; sometimes the knots are of 48 feet only, and divided into 8 fathoms of 6 feet each, in which case a glass running 28 seconds is used. But be the assigned length of the knots what it may, the decimal division of them is considered the most convenient. The log-line is wound upon a reel which turns with ease.

When the log-line is to be used, the pin is fixed into its hole, and while one man throws the log into the water and lets out the line as fast as the log will take it, a second man holds the reel, and a third the glass. As soon as the offset mark has passed, the word *turn* is uttered sharply, and he who holds the glass turns it instantly, and watches the moment the sand has run out, when he calls out *stop*. The first man then closing his hand suddenly, stops the further progress of the line. The jerk occasioned by the stoppage pulls out the pin (which if the line were bent on exactly in the middle of the before mentioned loop would be difficultly effected), the log no longer held in its position by the pin presents its edge to the water and is easily drawn in. As soon as the line is stopped, the number of knots and fathoms are read off, representing as many miles and parts of a mile. Thus three knots will be a velocity of three miles to the hour, three knots and five fathoms three miles and a half to the hour, &c.

The log-line, however, is apt to become faulty by heat or moisture, and the glass that measures the time may be incorrect, hence the necessity of frequently examining both. The space between the knots may be measured with a rule, and the accuracy of the glass ascertained by a watch with

a seconds' hand or by the vibrations of a plummet *q, v.* The following rules for correcting the errors in reckoning, occasioned by a faulty line or glass, are given by Mr. Norie in his Practical Navigation.

When the log-line is truly divided and the glass faulty.

Rule.—Multiply the distance given by the log, by 30; divide the product by the seconds run by the glass, and the quotient will be the true distance.

When the glass is true and the log-line faulty.

Rule.—Multiply the distance sailed, by twice the measured length of a knot, then point off two figures to the right, and the remainder will be the true distance.

When the glass and log-line are both faulty.

Rule.—Multiply the distance sailed by the log, by six times the measured length of a knot, and divide the product by the seconds run by the glass, the quotient, pointing off one figure to the right, will be the true distance.

To find the length of a knot corresponding to a glass running any given number of seconds.

Rule.—Add a cypher to the number of seconds run by the glass, and divide this by 6; the quotient will be the proportional length of a knot in feet.

This instrument, the log, independent of its particular use for measuring the velocity of a ship's way through the water, may be also employed, and is indeed well adapted, for measuring the surface velocity of a river; thus from a low bridge, or better still, from a boat or raft moored in the middle of the stream, the log may be thrown out, and as it will be carried away by the current, while the observer remains in the same place, the rapidity of that current may be ascertained. But the log has two great inconveniences for the traveller by land, the bulk of the instrument with its reel, and the necessity of employing three persons in the operations, both these however may be avoided by the following—

Substitute for an ordinary log and log-line.—Construct a small log of 3 inches radius which may be carried in the pocket, and use a trout line and reel for a log-line. Having previously to bending on the line, marked the offset, or *stray line,* set off a distance of 50 feet, then fix the reel to a stick at the stem of a boat, or in any other convenient way, and with stop watch in hand let the line run out the 50 feet, stopping the watch at the moment the mark passes; when, on dividing 30 by the number of seconds observed, the quotient will be the number of knots to the hour. When the tra-

veller has no stop watch, the better way would be to apply the watch to his ear, and count its beating, of which 5 usually go to a second; in this case the dividend will be 150 instead of 30, and the divisor the number of beats observed.

OMBROMETER, OR RAIN-GUAGE.

The simplest form of the rain-guage, that recommended by the Committee of the Royal Society, is still a cumbersome object for a traveller to take with him; if, however, he be stationary, and get the instrument constructed, he should do so. "It consists of a tin or zinc box, exactly ten inches by the side, open above, and receiving at an inch below its edge a funnel, sloping to a small hole in the centre. On one of the lateral edges of the box, close to the top of the cavity, is soldered a short pipe in which a cork is fitted. The whole should be well painted. The water which enters this guage is poured through the short tube into a cylindrical glass vessel, graduated to cubic inches and fifths of cubic inches. Hence one inch depth of rain in the guage will be measured by a hundred inches of the graduated vessel, and 1-1000th inch of rain may be very easily read off."

"It is very much to be desired that more than one of these guages should be erected, or at least one placed with its edge nearly level with the ground, and another upon the top of the highest building, rock, or tree, in the immediate vicinity of the place of observation, the height of which must be carefully determined; it having been satisfactorily ascertained that the height of the guage above the ground is a very material element in the quantity of rain which enters it. The quantity of water should be daily measured and registered at 9 A.M."*

This daily registering at 9 A.M. applies of course to stationary observations only, and even then is useless unless rain has fallen. In general, travellers will set up their rain-guages and observe with them, when and where they can.

To the instrument just described we would add, a thermometer for taking, at the time of a shower, the temperature of the rain. This thermometer should have a flattened bulb and a bent tube, and so fitted into the funnel of the

* See "Report of the Committee of Physics and Meteorology."

guage that its whole scale be above the surface, while the flattened bulb be exactly under the hole of the funnel, so that the rain-water may fall directly on its flat surface and communicate its temperature to the instrument.

ATMOMETER FOR ESTIMATING THE EXTENT OF EVAPORATION.

Leslie very justly says, that observations on evaporation are as interesting as those on the fall of rain. Unfortunately, however, evaporation is modified by so many causes, that precise observations of its amount are by no means easy. The atmometer described by Leslie is perhaps the most correct; but it is an instrument which can hardly form part of a traveller's baggage. The progress of evaporation therefore must be deduced from the observed indications of the dew point or of the wet bulb hygrometer. Stationary observers, however, should not fail to make regular observations with the atmometer, and such travellers as can transport one, will be doing much service to science by using it frequently. The instrument consists of a porous earthenware ball, with a long attached graduated glass tube; it may be had of any of the principal philosophical instrument makers.

ANEMOMETER, OR WIND-GUAGE.

Of the different instruments that have been constructed for ascertaining the force of the wind, that of Mr. Osler, of Birmingham, is perhaps the most complete; for by its adjustments, it registers for itself, and furnishes, without trouble, all the requisite data of force, direction, duration, &c.; but the apparatus is bulky and fit only for setting up at fixed observatories. Of portable instruments, such as a traveller may easily carry with him, the best is that known as LIND'S WIND-GUAGE. It consists of a glass tube bent into the form of an inverted siphon, the branches being close and parallel. It is open at both ends, at one of which a metallic cylinder, of equal bore with the tube, is fixed, bending at right angles to the tube. The instrument is set upright and turns on a pivot; to the top of it, a small vane is attached, so that the open metal orifice is always presented to the wind. The tube is graduated and filled

with water to 0° of the scale. Sometimes both the tubes are graduated, in which case the amount of the depression of the fluid in one branch of the guage, and of its ascension in the other, being added, gives the force of the wind. If only one of the branches be graduated, then twice the amount of the ascent or descent from 0 of the scale is the height of the column of water supported.

The length of the column being observed, the following table (extracted from the Report of the Committee of Physics of the Royal Society) will give the force of the wind on every square foot of a body opposed to its direct action:—

Height of the Column of Water.	Force of the Wind in Avoirdupois Pounds.	Common designation of such a Wind.
Inches.		
12	62·5·	
11	57·29	
10	52·08	Most violent hurricane.
9	46·87	
8	44·66	A very great hurricane.
7	36·55	A great hurricane.
6	31·75	A hurricane.
5	26·04	A very great storm.
4	20·83	A great storm.
3	15·62	A storm.
2	10·42	A very high wind.
1	5·21	A high wind.
0·5	2·60	A brisk gale.
0·1	0·52	A fresh breeze.
0·0	0·26	A pleasant wind.

In great degrees of cold, a saturated solution of sea-salt may be used instead of water, the specific gravity of which is 1·244. If the force in the above table, for any height, be multiplied by the specific gravity, the product will be the true force, as measured by the solution.

If an index be added to the instrument, and the disc on which it stands be divided like a compass card, then, by setting the instrument with the North and South points of the card in the direction of the meridian (true); or if magnetic to be so specified, the direction, as well as the force of the wind, will be indicated.

DROSOMETER.

This is an instrument for measuring the quantity of dew. We recommend for this purpose a metal funnel, of five inches in diameter, sloping at an angle of 30°, and terminating in a small hole and very short pipe. This funnel must screw into the neck of a glass tube of equal bore, and a quarter of an inch in diameter. This tube must be graduated, so that each degree may indicate the thousandth part of an inch on the external aperture. The bottom of the tube must screw into a solid foot, so that the instrument may stand firm. To observe with this instrument, see OPERATIONS.

ELECTROMETER.

There are few meteorological data more interesting than those respecting the electrical state of the atmosphere ; but, unfortunately, this is a subject not yet fully understood. The electricity of the air is observed by means of electrometers or electroscopes, of which there are several of various constructions, as De Saussure's, Volta's, Singer's, Bohnenberger's, &c. Leslie prefers Singer's, but Bohnenberger's has the advantage of indicating the *kind* of electricity communicated to the conductor.

Whichever of these instruments is used, and the choice may be left to the option of individuals, it must be connected by a fine copper wire with a conductor, which, as the report of the Committee of Physics of the Royal Society observes, may be any temporary contrivance as "a common fishing rod, having a glass stick well varnished with shell-lac, substituted for its smallest joint ; to the end of the glass must be fixed a metallic wire, terminating in a point, and to the end of this point the copper wire must be fixed which connects the conductor with the electroscope.

CYANOMETER.

This is an instrument constructed by De Saussure for measuring the intensity of the blue colour of the sky. It consists of fifty-three slips of paper, about a quarter of an inch broad, and one inch long, stained with the successive

shades of blue, from the lightest to the darkest. These are arranged in a circle, and the colour of the heavens is compared with these, and the corresponding tint determined.

The great defect of this instrument is the difficulty of obtaining comparative instruments; and even the same Cyanometer changes its tints by exposure to air and light. Other cyanometers than that described, have been proposed, but none that we know of are perfect. This is to be regretted, as the intensity of the colour of the sky, varying with the state of the atmosphere, and with the heights at which the observation is made, it becomes interesting to note the tint of the heavens under different circumstances.

PHOTOMETER.

This instrument, though not strictly necessary to the traveller, is so extremely portable, particularly that form of it which is called the portable photometer, that we cannot but recommend to the traveller to have one with him. The object of this little delicate instrument is, to ascertain the relative intensities of light, as depending either on the times of the day, the seasons, or the heights of places. Its applications are very various, and it serves to supply some very interesting data of general physics.

INSTRUMENT FOR OBSERVING THE DIRECTION OF THE UNDULATORY MOTION OF EARTHQUAKES.

For this purpose, treacle or other viscous substance has been recommended, which being put into a bason, will, by the marks it leaves after agitation, show the direction of the wave, and in some degree its force; but treacle or other viscous fluid is not always to be had, particularly by the traveller, and moreover, in order to render the observations made at different places comparative, the same substance, and of the same specific gravity should be employed. Fortunately water will answer the purpose, though not so well as treacle.

We recommend then, a tin or copper bason, hemispherical within, and having its inner surface whitened, but not polished; the composition used must be such as water will wet but not dissolve. From a point in the exact centre of the bottom, let black lines be drawn to the number of 32, and at the top let the usual letters and degrees of the compass be marked; in addition to this let black and equidistant horizontal circles be painted on the inner surface of the bason, these may be

a quarter of an inch apart, the bason being six inches in diameter. Set the bason with its North line in the direction of the true North, then pour into it a quantity of water equal in depth to one inch, and sprinkle on its surface some light powder, no matter what, so that it will float and not dissolve, as fine sawdust, or bran, or scrapings or raspings from a bit of wood, or any substance of like kind. The bottom of the bason should be lested with lead, that it may stand firm. Any undulation of the water will leave the powder adhering to the side, and thus show at once both the direction and strength of the shock; the latter being indicated by the height of the horizontal line to which the water attains.

EUDIOMETER.

This is an instrument for estimating the quantity of oxygen contained in atmospheric air; many and various Eudiometers have been constructed, but as the experiments that have been made with them prove, that the constituent elements of the air are nearly identical in all places, at the tops of the highest mountains, and in the plains, and in all parts of the world; and as, moreover, experiments with the Eudiometer require the use of certain re-agents, it is an instrument which the traveller may very well dispense with.

INSTRUMENTS FOR OBSERVING TERRESTRIAL MAGNETISM.

These, for a traveller, will be a dipping needle furnished with intensity needles, a variation compass, and the small portable apparatus for the horizontal intensity, usually called Hansteen's apparatus. For the reasons why we merely indicate these instruments, without giving any description of them, see OPERATIONS.

The remaining instruments mentioned in our list require no particular description.

Great care must be taken in transporting some of the above described instruments, as they are delicate and subject to derangement. Until the traveller comes upon the ground of his observations, some of the more delicate of the instruments may be put among his linen, which, by its elasticity, will secure them from shocks and other accidents.

SECTION II.

OPERATIONS.

The scientific traveller, adequately supplied with proper instruments, needs no instruction from us regarding the application of them to the several operations he may have to perform in the course of his travels : but for the unscientific, and for those who cannot take instruments, or may have lost them, we shall point out various modes of operation sufficiently exact for general purposes. Many of these operations comprise what is termed *Practical Geometry on the ground*, on which subject a treatise was formerly published by Professor Landemann, of Woolwich, some of whose more necessary problems we shall give as eminently useful to the traveller.

Previous however to treating of operations requiring the aid of even the simplest contrivances, we will speak of—

MEASUREMENTS BY THE EYE.

There are many cases, in which the traveller is desirous of ascertaining heights and distances, which he cannot measure for want of even make-shift instruments, or because he has no time for measuring, or because the objects are inaccessible. It is therefore of great consequence that he should have so practised his eye previously, as to be able to judge by it alōne, with considerable accuracy, of heights and distances ; and this he must learn to do under all circumstances of atmospheric influence, as objects appear nearer or further removed, more or less high, larger or smaller, according to the different states of the atmosphere. In estimating heights and distances by the eye it must be remembered, that the angle subtended diminishes with the distance, so that in measuring a height or distance by the repetition of any unit, whether it be a hundred yards or ten feet, a less and less apparent space must be taken for the unit, as the part to which it is applied recedes from the eye. Thus it will be found that if a person who can judge very accurately of the dis-

tance of 100 yards along the ground, from the place where he may be standing, were to take the same apparent length in his eye for a second 100 yards, it will, on measuring, prove to be too long; a third unit of 100 yards, extended in this way, would be still farther from the truth, and so on; he must therefore take less and less as he measures onwards with his eye. The same is true of heights: the first 10 feet from the ground may be very correctly estimated, but the last ten at the top, will in reality appear shorter to the eye, and therefore a space successively shorter must be taken for the ten feet as we ascend. We have hitherto supposed the ground horizontal, and the object whose height is to be estimated, vertical and in the same plane; now it is clear that if the ground rise or fall in front, or is wavy, and if the plane of a lofty object recedes, as in a mountain, or if the planes are different, as in the several parts of the same building, or the different buildings of a citadel, &c., the measurement by the eye must be modified accordingly. Thus, if the ground rise gradually, the unit of measure must be less diminished in proportion as the rise be greater, and, *vice versa*, if the ground descend from the spectator. If the ground be undulated, it is very difficult to measure it by the eye, and if the bottoms of the hollows are not visible, or a broad river unseen intervene, it is almost impossible: in either case the best way perhaps is, to judge of the distance by the apparent size of any object whose natural dimensions are known, such as men, animals, trees, buildings, &c. But distances so estimated are little to be relied upon. As regards heights, the higher portion of a mountain is more remote than the lower, and hence in judging of its height the unit of admeasurement, as in judging of distances, must be successively diminished. If one hill be in front of another, or one building, or part of a building, be in front of another, it is extremely difficult to judge of the height of the more remote object; not only because the measurement of the eye as applied to the nearer, is not applicable to the more remote, but because a greater or less portion of the more distant is cut off by the nearer, and the portion cut off is greater or less according to the height of the nearer object, and its distance from the more remote. It need hardly be observed, that greater units of measure should be used for distant than for near objects. In clear weather, and also immediately after rain, distances appear less, because the objects being better defined, seem nearer to the eye. In a mist, objects

appear larger than they really are, not only because the image painted on the retina is magnified, but because the indistinctness of the object induces us to believe it further removed from us than it really is. It should not be forgotten also, that refraction makes objects on the horizon appear higher than they are, and that the curve of the earth's surface depresses objects more or less below the horizon according to their distance. The greater the density of the atmosphere, the greater its refractive power: hence this power is decreased by heat and augmented by cold, and hence the height of the same object will appear different at different seasons and at different times of the same day. It is therefore very difficult to make a correct allowance for the effect of refraction in all cases, more particularly when the precise distance is unknown; for even tables are of no use without this latter *datum*.

Independent of height and distance, other appearances are often judged of by the eye, and as these are greatly affected by distance, by light and shade, the traveller should be careful not to be led into error by optical delusions. Thus the colours of objects are greatly modified by the quantity of air which intervenes between the objects and the eye. Every one knows that distant mountains have a greyish tint approaching to blue, while in reality they may be clothed with a rich verdure, or be barren rocks of various colours, &c. Distance also softens the asperities of objects far removed, so that what may appear to have a smooth surface or regular contour, may, on a near approach, present the greatest ruggedness. But to enter into such details would lead us too far, we must leave the traveller to form his own experience in these matters; recommending only that he so tutor his eye as to be able to reckon upon it with some degree of certainty. We shall now proceed to objects of a more positive character.

ESTIMATION OF DISTANCES AND HEIGHTS BY ACTUAL MEASURE.

And first let us premise that the instruments required are—sticks, the straighter the better; they may be cut rough, from the forest; or straight reeds or canes; or if these cannot be had, men may supply their place, and in some cases stones will answer the purpose, as we shall presently see; a rope or line, or for want of such, the traveller may twist one of grass, straw, or other similar material, which will some-

times answer well enough. In some climates there are long climbing plants or trailing roots which may occasionally do for cords.

STANDARD MEASURES OF LENGTH.

The chief purpose of the sticks and lines just mentioned or their substitutes is for measuring; but before they can themselves, be used as measures, their own length must be determined; hence the traveller, before setting out, should ascertain precisely what parts of his own body correspond to a yard, a foot, &c. He should also know the exact height of his eye above the ground, and have learnt to pace regularly, both as to the length of his step and the number of steps he takes in a given time (he should also ascertain the value of his horse's paces as regards their length and time). Having thus his standard measures always with him, he can at any time transfer them to his sticks or ropes. As the measurements from the body will, however, always be liable to inaccuracy from the want of sharp lines and angles, the joints and extremities being rounded, this kind of standard should be had recourse to, only as a last resource; the traveller would, therefore, do well to have the foot or yard ascertained on some part of his habitual dress, on his gun, &c.

TO WALK IN A STRAIGHT LINE.

It may appear to many that any one who is sober can walk in a straight line, and that directions for such a simple operation are altogether superfluous; but this is by no means the case. To walk in a straight line, fix your eye upon two objects, such as two trees or bushes, or stones, or the corner of a wall and a house, &c., so as to have them exactly in a line before you, then step out, keeping these objects constantly in a line; on approaching within a few paces of the first object, look forward for a third in the same line, keeping it and the second in a line; arrived near the second, look out for a fourth, and so on. Should there be no objects such as we have mentioned, there will generally be found marks, as tufts of grass higher and of deeper colour than the rest, or low plants easily distinguished, or irregularities in the surface of the soil, &c., which will answer the purpose. If not, two men, if you have

any with you, should plant themselves in a line in front, and then on approaching the nearest, stop and send him on to place himself in the line behind the other, and so on. In using fixed objects, one should be chosen as far off as possible, with which the intermediate ones should always be in a line, and the reason is, that the slightest deviation from the straight line is instantly detected. It is also desirable to have the objects as nearly as possible in the same line of vision, thus the stems of two trees are better objects than a stone on the ground and a tree in the distance, that can be seen only by raising the eye.

TO MEASURE DISTANCES BY PACING AND TIME.

Let the traveller accustom himself to walk so as to take exactly $2\frac{1}{2}$ feet at a step; then 120 paces will be 300 feet.* He may then measure short distances by pacing them. If the distance be too great for this, and the traveller's attention be required to various objects as he proceeds, which would interfere with his counting, it may be estimated by the time required in going over it.† Thus, if the traveller accustom himself to walk 600 paces in five minutes, or 120 in one minute, he has only to look at his watch on starting and on arriving, and multiply the number of minutes he has been walking by 120, to have the number of paces, and this by $2\frac{1}{2}$ will give him the number of feet; still greater distances may be calculated at about four miles in an hour and a quarter. Halts, if only for a minute, must, of course, be deducted in estimating by time. If the traveller be on horseback, he should know the value in length and time of his horse's paces in order to measure by them. It is not an uncommon thing to estimate great distances by days' journey. In such case the value of the day's journey should always be indicated, for it is different on foot, on horseback, on camels, asses, &c.; different on firm soil, or on difficult ground, as sand, or through woods; different in ascending and descending hills, &c. Persons who have a good ear for time, may greatly assist the regularity of their walk by singing as they go along some tune in which, as in a quick march, the measure is distinctly marked; or knowing how long they take to sing a

* In sand or slippery ground, the pace, though of equal length, measures less ground, for the foot slips back at each step.

† A pedometer is a useful instrument for measurements by pacing.

song, may repeat this air over and over as they go, making a knot on a string, or otherwise marking the number of times they have repeated their melody. A Catholic or a Mahometan thus repeating his prayers with a rosary, may convert the latter into an itinerary measure.*

OF MEASURING DISTANCE BY SOUND.

Sound flies at the rate of 1142 feet in a second, or about a mile in $4\frac{1}{3}$ seconds; or a league in fourteen seconds; or thirteen miles in a minute; but sea miles are to land miles nearly as seven to six; therefore, sound moves over a sea mile in $5\frac{3}{4}$ seconds, nearly, or a sea league in sixteen seconds; sound can be heard nearly twice as far on the water as on the land. From the velocity of sound, then, distances can be measured when the cause of the sound can be seen. Thus, by observing with a stop watch or otherwise, the time which passes between the flash of a musket or cannon, and the sound of the discharge, the distance from the place of discharge may be estimated. The distance of a thunder cloud may be known in the same way by observing the lightning, and counting the number of seconds which elapse before the thunder is heard. The stroke of the wood-cutter's axe may sometimes be heard at a considerable distance, and if the blow can be seen, the distance may be estimated.

The banks of rivers sometimes echo any sharp noise produced upon the water, and this, in a dark night, on a broad river, may be sometimes useful; for, by striking the water a smart blow with the flat of the oar, and observing the time between it and the echo, the distance from the bank may be guessed at; or, if both banks produce an echo, the difference between them will serve to indicate which bank is nearest, for the nearer the bank the more immediately will the echo follow the blow.

TO MEASURE A STRAIGHT LINE.

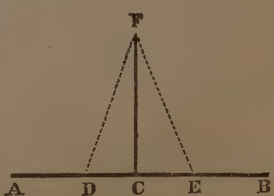
This may be done either by pacing it, taking care to walk in a straight line as already directed, or by means of rods, or a cord. When a rod is used by one person alone, he must begin by marking off his line; which may be done

* Far be it from us to insinuate that so holy a thing as prayer should be profaned; but surely there can be no harm, after a lonely traveller has beguiled his weary way with orison to his heavenly protector, to learn from his beads how far he has journeyed.

with little sticks or stones; then let him measure with his rod, taking care at each remove to place the rod exactly at the spot where its extremity reached before it was taken up. If there be two persons, it is not necessary to mark off the line by sticks or stones. One person must keep some objects in a line by his eye, and direct the other, who measures, to keep in the direction, by word or a signal with the hand. In measuring with a cord of any kind, if there be but one person to perform the operation, he should begin by placing sticks in the direction to be measured, but backwards from his starting point: he must next make a loop at one end of his cord so as to fix it by a stick in the ground; then going forward and stretching his cord; having his back turned to the place where he is going, he looks along the row of sticks (three are sufficient) and stretches his cord in the exact line. He then fixes a stick for a mark, goes back to pull up the stick which fixed the end of his cord, fixes it again at the new mark and repeats the operation as far as may be necessary. If there be two persons, each walks forward with one end of the cord in his hand, the one in advance sticking up a picket at the end of the stretched cord, which the one who follows takes up. The number of pickets mark, of course, the number of times the length of the cord has been gone over. In this mode, it is the business of the hinder person to see that the other stretch the cord in the direct line, which he does by keeping certain advanced objects, natural or set up by him, in his eye. If no sticks are to be had, stones may supply their place, and if there are no stones, the spot where the cord ends, must be marked by scratching the ground, and each should count to check the other.

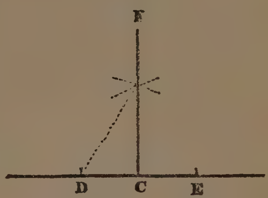
TO RAISE A PERPENDICULAR FROM ANY POINT ON A GIVEN LINE.

Measure on the given line A B, two equal distances D and E, on either side of the given point C; fold a cord in two; marking the middle; fasten the two ends of the cord by pickets at D and E. Stretch the cord tight, and from its middle F, draw the line F C, which will be the perpendicular required.



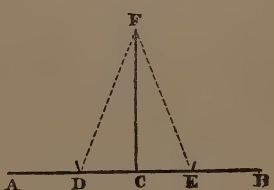
Care must be taken in fastening the two ends of the cord, after the middle has been found, to take up exactly the same quantity of cord, or the two sides of the triangle, when the cord is stretched, will be of unequal length.

For want of a cord, a long stick or perch may be used. Having measured off, as before, equal distances on either side of the point C; let one person hold the perch by one end at D, while another describes an arc with it, then doing the same thing at E, the intersection F, of the two arcs will be the point from which to draw the line to C.



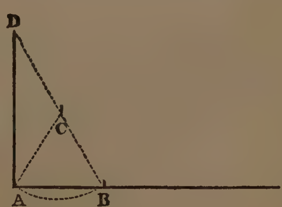
FROM A GIVEN POINT OUT OF THE LINE, TO LET FALL A PERPENDICULAR TO IT.

Fold a cord, whose length must be more than double the nearest distance from the point to the line, into two equal parts; fix the middle at the given point F. Stretch the two halves till they meet the line A B in D and E, find the middle between D and E, as at C, and draw F C.



TO RAISE A PERPENDICULAR AT THE END OF A LINE.

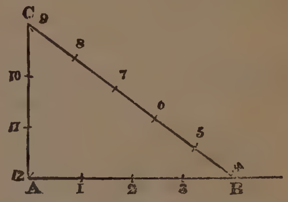
Having marked the middle of your cord, fix one end at A and the other end at such a distance from this, that when the cord is stretched at the middle it may form nearly an equilateral triangle; fix a stick at the apex C of the triangle; detach the end A, and move with it towards D, then keeping the cord touching C, stretch it straight in a line



with C B, and its extremity D will be the point from which to let fall the required perpendicular.

The operation may be performed by sticks. For this purpose lay the stick or perch with one end at A, and in a direction to form an angle with A B of about 60 degrees ; then keeping fast the end C, where a picket must be placed, move the perch round this point, as round a pivot, till the other end coincide with the line A B ; plant a picket at B, and slide the perch along towards D, keeping it in a line with C B ; in such position, one end of the perch touching C, the other extremity D will be the point for the perpendicular required.

Another and more expeditious method of raising a perpendicular is by means of the numbers 3, 4, and 5, or any multiples of these. Thus measure off and mark upon your cord 12 equal divisions, say feet; fix the two extremities of the cord at the point where a perpendicular is to be raised as at A. Stretch the cord along the given line towards B, set a picket at the 4th division ; turn the cord tight outside of this picket, then seizing the cord at the ninth division, stretch it into a triangle, and fix the picket at C, when C A will be perpendicular to A B.



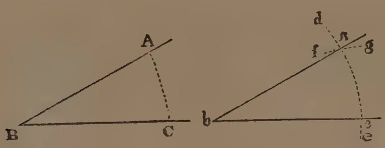
A cross-staff is very useful for setting off perpendiculars; but we have supposed the traveller to be without instruments ; he may, however, have the means of supplying the place of a cross-staff by a very simple contrivance, which will answer well enough for certain purposes. Draw two lines perpendicular to each other on a piece of paper, place this on the cover of a book, keeping it there by five pins or needles, one at each extremity of the lines, and one at their intersection ; place the book as horizontally as possible on a stone, or raise a little mound of earth for the purpose, and use this as a cross stick ; or stick the pins at one of the angles of the book cover, and along its two contiguous outer edges. Two flat sticks may be fastened cross-wise, and stuck firm on the top of another stick, having first marked two lines perpendicular to each other along the upper surface of the flat sticks, on which lines set up pins as before. Perpendicular lines are easily obtained by folding a piece of paper.

TO DRAW A LINE PARALLEL TO A GIVEN LINE.

From the extremes of the given line, or at any convenient distances along it, raise perpendiculars by any of the means already mentioned ; take equal distances along these, or a given distance, if required, and the line joining the two points, marking such distances, will be the parallel line required.

TO MAKE AN ANGLE ON THE GROUND EQUAL TO A GIVEN ANGLE.

Set off any number of equal parts from B to C, and from B to A, and with the same parts measure A C ; then from



any point b, with the length or radius B A describe an indefinite arc d e ; from any point c in this arc as a centre describe with the length A C an arc f g intersecting the arc d e in a. Join c b and a b and the angle a b c will be equal to the angle A B C.

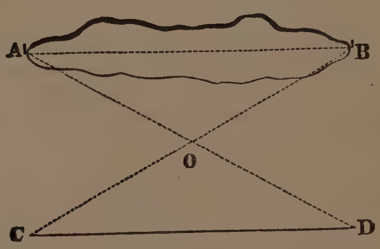
TO MEASURE AN ANGLE OF A BUILDING, ETC., HAVING NO PROPER INSTRUMENT.

If from the inside, measure off equal distances along the two walls, from the angle, and place pickets or stones at the points, then measure across from point to point, that is, the cord of the arc subtended by the angle which the walls make. Now draw a line on paper and take from a line of equal parts (a slip of paper frequently doubled will do for a make-shift scale of equal parts) as many as you have measured feet or paces, &c., and mark that distance on your line ; from one end describe an arc with this length as a radius, and intersect this arc by another struck from the

other extremity of the base line with a radius corresponding to your measured cord. Draw a line from the first point of the base to the intersection, and you will have on paper an angle similar to that you measured. Apply a protractor, and you will have the value of the angle. At all events, it will be thus set down, and may be ultimately measured. If it be more convenient to measure the angle from the outside, draw lines in prolongation of the two walls or faces of the building, and operate with these as just described. This method is equally correct with the former, as opposite angles are equal. This problem may be usefully applied by the traveller, when, being without instruments, he would give as correct a plan as possible of the exterior walls of ruined cities, edifices, &c. On the spot it will be sufficient to draw the plan as correctly as possible by the eye, writing the dimensions by the sides of the lines.

TO ASCERTAIN THE LENGTH OF A LINE AS A B, ACCESSIBLE ONLY AT ITS TWO EXTREMITIES.

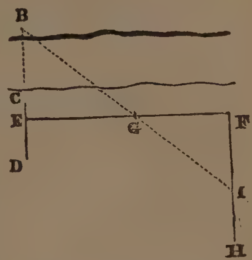
Choose a point O, accessible to A and B, draw A O, O B,



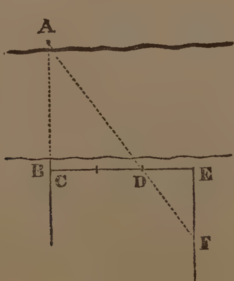
prolong A O to D, and make O D equal to A O, prolong B O to C, and make O C equal to B O, and C D will be equal to A B the required line. The length of a small lake or marsh may be taken in this way.

TO ASCERTAIN THE BREADTH OF A RIVER, MARSH, ETC.

This may be done in different ways. 1st. Method—fix upon some tree, or bush, or stone, or other fixed object on the opposite edge of the river, as at B; trace a line C D in the direction of B, and perpendicularly to the axis of the river. From E, or some other convenient spot, raise the perpendicular E F, of any convenient length predetermined, so as on arriving at half the intended distance E F, a stick may be set up at G. Arrived at F, trace the line F H perpendicular to E F, and walk along it backwards till the stick at G come in a line with B, as at I, and plant a picket there, then measure I F, which will be the same as E B, from which take the distance C E, and the remainder will be the breadth of the river.



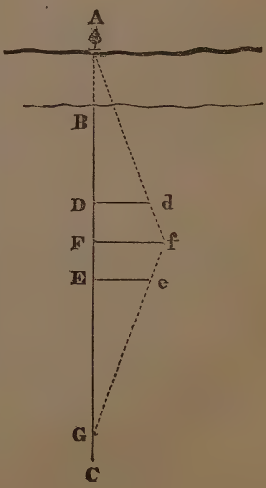
2nd. *Method.*—If the river be very wide, plant the stick G not at the half of E F, but at 2-thirds or 5-sixths. Thus, suppose A B, the breadth of the river, be very great, the preceding mode would require the line E F to be of equal length at least. To save trouble and time, therefore, make C D equal to 2-thirds of C E, as in the figure, and planting a stave at D, proceed as before, till, being on the line E F, you find D in a line with A, plant your picket at F, and measure F E, then D E will be to E F as C D is to C A, from which take B C and the remainder will be the width of the river.



3rd. *Method.*—Set up perpendicularly at the edge of the river, a stick A about four feet long, then going back a few paces, set up another B somewhat longer, say five feet, in such a direction as that the two sticks may be in a line with

some distinct object E directly opposite, and that the visual ray D E passing along the tops of the two sticks, may fall upon the foot of the object E on the other side. Then, in any direction where the ground is most level, set up a third stick C of equal height with the stick A, and at the same distance from B, as B is from A, then looking over the tops of the sticks B and C, observe where the visual ray falls, as at F, then measure B F, which will be equal to B E, and by deducting the distance A B, the remainder will be the width A E of the river. Or the same may be done horizontally thus :—

4th. *Method.*—Draw the line B C in the direction of the chosen object A; at any parts D and E, raise perpendiculars of equal length, more or less, according to circumstances; plant staves at the ends d and e of these perpendiculars, then at half the distance D E raise another perpendicular, and walk along it till d A come in a line, and plant the stave f, then go back on the line A C and walk straight along it backwards till you bring e f into line, which will be the case at G. Measures G F, and deduct from this the distance B F, and the remainder will be the breadth of the river. This method, though more tedious, is more correct than the former or 3rd method.

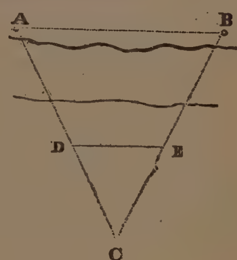


N. B. Be it observed, however, that all these modes of measuring the breadth of rivers or other inaccessible distances cannot be even tolerably exact, but in as much as the ground on which the operations are performed, and the object on the opposite bank of the river, &c., are on the same plane. The traveller should, therefore, choose his position accordingly.

Different expeditious make-shift methods have been given for ascertaining inaccessible distances, as by looking over the two edges of a hat, so as to bring them into a line with the object whose distance is required, and then, holding the hat and head steady, turning upon the heel, and observing where the visual ray falls upon the ground, and measuring to that spot; but it is very difficult to keep both the hat and head quite steady in turning, and as the slightest variation in their position will most materially affect the measured distance, we by no means recommend this mode, unless indeed the traveller, by long practice, is able to accomplish it with sufficient precision.

TO MEASURE THE DISTANCE OF TWO INACCESSIBLE OBJECTS FROM EACH OTHER.

Plant a staff at C, from which both A and B may be seen; now, by any of the preceding problems find the length of C A and C B. Make C D as many parts of C A, as you do C E of C B, and join D E. Then, as C D is to D E, so is C A to A B.

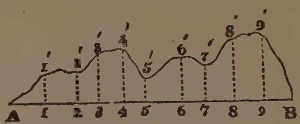


TO TAKE THE PLAN OF A WOOD, A MARSH, A LAKE, A CRATER, OR OTHER HOLLOW, ETC.

Set up stakes at the angles, measure from stake to stake by pacing or otherwise, taking also the value of the several angles as previously directed. Make a rough sketch as you go, on which set down the length of the lines and the value of the angles. At a convenient time, protract it.

TO TAKE THE PLAN OF ANY CROOKED LINE, AS OF A RIVER, A NECK OF LAND, ETC.

Trace the line A B by pickets or stones, measure along A B till you arrive at the first bend, then strike off perpendicularly towards it and measure 11′, come back and walk from 1 to 2 on the line A B, strike off again to the next bend measuring 22′ and so on, noting the distances A 1 and 11′, 12 and 22′, 23 and 33′, &c.



To map a country in this way, without even a compass, would not only be an endless task, but would, after all, give but a very incorrect representation: all these methods therefore are only make-shifts, and very good in particular cases, for want of better.

Before we speak of the measurement of heights and depths, we may observe that it is not sufficient to have the form of objects such as woods, lakes, &c., but they must be laid down in their true position as regards the meridian, this is therefore the place to show how to obtain a meridian line.

TO OBTAIN A MERIDIAN LINE.

There are various ways of doing this approximately.

1st. *Method.*—Place a stick upright in the earth, a little before midday, having previously drawn two or more concentric circles of which the stick is in the centre. Observe the length of the shadow, and when, after twelve o'clock, the shadow is observed to be of the same length, take half the distance between the point where the shadow was, and where it now is, and a line passing through the bisection and the centre of the circles will be in a plane of the meridian.

N. B. This method is imperfect by reason of the change in the sun's declination between the observations, and from the indistinctness of the termination of the shadow.

2d. *Method.*—Suspend two plumb lines at the two ends of a rod turning horizontally on a pivot; now, when the star Alioth of the great Bear is near the meridian, bring the plumb lines exactly in a line between it and the eye, and when the polar star comes into the line also, the four objects

are in the plane of the meridian nearly. The plumb lines may be kept steady by plunging in pails of water.

N. B. This is as exact as can be expected without the assistance of a telescope, but it will only do for the Northern Hemisphere.

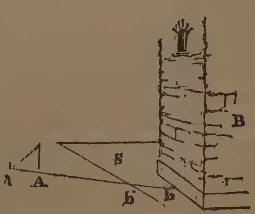
3rd. *Method.*—A little before midnight observe the altitude of a star and note the time by a chronometer or good watch ; continue looking occasionally, till the star, sinking again, attains the same altitude. Note again the time. Half the time elapsed between the two, added to that of the first observation, will give the hour when the star is on the meridian. At this hour precisely the next night, fix a telescope so as the star may be in its axis, and the instrument will be in the plane of the meridian. Or bring two plumb lines as described above in a line with the star at the exact time, and the two plumb lines will be in the plane of the meridian.

The north and south may sometimes be known sufficiently for certain purposes by the effects of the sun, and of the known prevailing winds of a country on its vegetation. Thus, in our northern hemisphere, there is a marked difference between the appearance of the north and south sides of the trunks of trees in exposed positions. The north being known, of course any other point of the compass is easily found.

By whatever means the meridian line be determined, the angle which it makes with one side of the object to be set down in a map or plan, must be ascertained and noted, so that not only the true form, but also the true position of such object may be given.

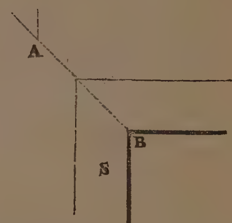
TO ASCERTAIN THE HEIGHT OF A BUILDING, WHEN THE BASE OF THE BUILDING IS ACCESSIBLE.

1st. *Method, by shadows.*—If the sun or moon be shining, set up perpendicularly and near the edge of the shadow S of the building B a staff A, of known length, and where its shadow ends, set up another staff a of any length, measure the distance A a between them, and note it, then leaving the staves standing, go to the base of the building B and turning your back upon it, place yourself on a line with A a as at b, and measure from thence

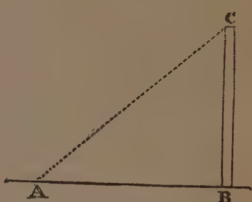


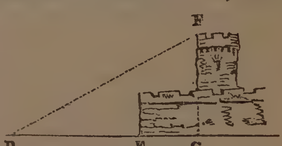
to the edge b′, of the shadow S of the building, then say as the length A a is to the height of the staff A, so is b b′ to the height of the building B.

It may be observed that the line b b′ is parallel to a line joining the angle of the building and the angle of its shadow; if then you be near such angle, the operation is more expeditious. Thus, set up the staff A in the line of these angles, measure its shadow without placing any other staff, and going forward at once, measure from the angle of the shadow to the angle of the building.

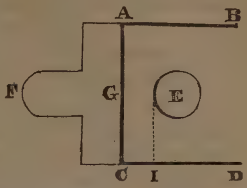


N. B. This method requires that the ground on which the shadow of the staff and that of the building fall, be in the same plane. We may also observe further, that for the application of this method it is not sufficient that the base of the building be accessible, it must be the horizontal projection of the point or line casting the shadow that must be accessible. Thus, if the shadow proceed from a wall, such as A B from B C, then B being the horizontal projection of C, the height of B C may be estimated by its shadow; but if the shadow proceed from F, it is evident the height of F cannot be determined by measuring to the base of the building, as from D to E; for to have the length of the shadow cast by the object F, the length E C must be added to D E. This length may sometimes be obtained though it is often impossible, and in such case the height of the object cannot be estimated by its shadow. Thus, if A B C D represent the outer wall of a building, and E a tower in its centre, if the direction of the shadow of this tower be perpendicular to the face A C of the lower and outer wall, then having measured the length of the shadow F G, and of the staff as before directed, place yourself in a line with the shaded face of the tower, and mark where-

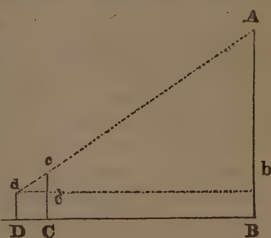




abouts on the outer wall C D, the visual ray along the face of the tower falls, as at I, and add the length C I to the length of the shadow F G. In any other position of the shadow it would be necessary to raise perpendiculars and take several measures, during which the length of the shadows would be changing and thus falsify the results of the operation. The height of a pyramid may be taken when the shadow is perpendicular to one of its faces, by adding half the length of the face to the length of the measured shadow before working the proportion.

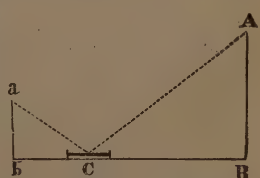


2nd. *Method, by sticks.*—When, for want of the sun, there is no shadow, the height of an object as A B may be taken thus. At a convenient distance from the base B of the object A B set up a staff C, and behind it a shorter one D, so as their tops d c may be in a line with A. Measure D C, d d, and D B, then say as D C is to C c—D d, or what is the same thing, d c′ is to c′ c so is D B. or d b to a fourth time, to which must be added D d or B b for the height required.



N. B. Here, as in the case of shadows the horizontal projection of the point A must be accessible, or in a situation to be estimated, otherwise this method cannot be employed.

3rd. *Method, by reflection.*—If the traveller have a looking-glass or a broken piece of one, let him place it as horizontally as possible on the ground as at C, then walk backwards till he sees the top of the object A B reflected in the glass. Now knowing the height of his eye from the ground, let him say, as his distance at b is from the point in C, where the image is reflected, is to b a, the height of his eye, so is the distance C B, which he must measure, to the height B A.



If the traveller have no glass, any other reflecting object will do, as a little water in a black cup or japanned tray, &c.,

or a natural pool of water. In the latter case, the observer must move till he bring the reflected object near the edge of the pool, marking the spot by a stick, to which he can measure. Observe also that in all cases of reflection from liquids, there must be no wind.

N. B. The same observation regarding the necessity of measuring to the horizontal projection of the point A or ascertaining it, holds good here as for the former methods.

4th. *Method, by a falling Body.*—From the top of a wall or tower whose height is required, let fall a stone, counting exactly by a stop watch or otherwise (see the next article) the number of seconds it takes to reach the bottom, then say, as 1 is to the square of the time, so is 16 to the height required. Thus, suppose the stone took four seconds in falling, then 1 : 16, (the square of the time,) as 16 : 256. When the object whose height is to be measured is such, that its whole height cannot be thus estimated at once, it may perhaps be done by successive stages, when of course the several heights must be added together. Care must be taken not to *throw* the stone; but just to open the fingers or hand and let it fall by its own weight.

5th. *Method, by actual measurement with a line having a weight at bottom.*—When the base of the building is inaccessible the length of the line to the horizontal projection of the point or line whose height is required may be ascertained by any of the previous modes of measuring inaccessible distances.

TO MEASURE TIME.

Short intervals of time may be measured by a pendulum vibrating seconds. For this purpose suspend a musket or pistol ball, or a stone, by a string, in such wise as from the centre of the ball or stone to the point of suspension, the length may be what is required for vibrating seconds according to the given latitude of the place. For these lengths we give the following table.

Degrees of Latitude.	Length of Pendulum.	Degrees of Latitude.	Length of Pendulum.
	Inches.		Inches.
0	39.027	50	39.126
5	39.029	55	39.142
10	39:032	60	39.158
15	39.036	65	39.168
20	39.044	70	39.177
25	39.057	75	39.185
30	39.070	80	39.191
35	39.084	85	39.195
40	39.097	90	39.197
45	39.111		

Or, if the traveller has learnt to count seconds regularly, he may measure time by counting.

Time may also be counted by the pulsations, which, for a man in health, are usually 75 in a minute.

Hours may be measured by the running of sand or dropping of water, as we shall presently explain.

TO CONSTRUCT A MAKE-SHIFT SUN-DIAL.

Supposing the traveller's watch to have got broken, or to be lost, he will find it very advantageous to be able to construct a sun-dial. There are a great variety of dials, we shall only mention the two simplest.

Draw on a card, or on a flat board, or on a piece of paper pasted to a board, or on a piece of sheet copper or lead, or on a piece of slate, a tile, or any flat surface that may be easily moved, three concentric circles as in the figure; the outer being a few inches in diameter if the dial is to be stationary, and smaller if it be required to be portable. Divide these into twenty-four equal parts for the hours, and each of

these parts into four for the quarters. Make the top and bottom the twelve o'clock lines; the right and left the six o'clock lines; and from the twelve at top go round with the other numbers from left to right as in the figure. Now, fix up in the middle, and perpendicularly with the plane of the dial, a wire or thin wooden rod, and your dial is made. It must now be set; this is done by raising the plane of the dial as many degrees as form the complement to the height of the pole; thus, if the latitude of the place be 35 degrees, the complement will be 55 degrees; or in other words, tilt up the dial so that the stile or wire may make an angle with the horizon equal to the elevation of the pole. At the same time, the twelve o'clock lines must be exactly on the plane of the meridian. This dial, which is called an equinoxial dial, in order to be universally applicable, must be marked on both sides, and the stile made to go through, otherwise it will only serve in the northern hemisphere, from the 22nd of March, to the 21st of September.

The next dial we shall mention is the horizontal dial, and is thus constructed. Draw the concentric circles as before directed, and through the centre E of this circle a line C A for the twelve o'clock line. Choose a point C on the line C A, and a little above the centre E of the concentric circles, and through this point draw a line perpendicular to

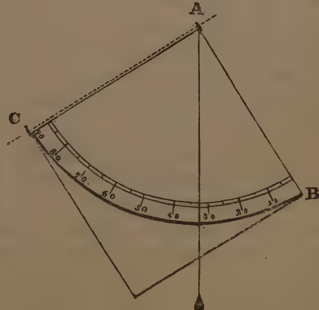
C A, and this will be the six o'clock lines; now draw through the centre E a line D E F perpendicular to C A. This done, draw from the point C a line C B, making with C A an

angle equal to the height of the pole or latitude of the place. Or open your compasses to the chord of 60 degrees and describe with this as a radius the arc A B. Then take the chord of the latitude and set it off from A to B, and draw the line C B for the stile, of which you thus obtain the true form. Set one leg of your compasses in E, and take the nearest distance to the line C B or stile's height, and turning the compass, mark with this distance, the point H on the line C A. On H as a centre draw the quadrant G E, and divide it into six equal parts, and each part into four for the quarters. Lay a ruler to H and to those equal parts in the arch severally, and where the ruler cuts the line D E F, the points are those through which the hour lines must pass. Then lay the ruler to the point C, and to those marks on the line D E F, and draw the hour lines. Set off the same distances on the line D E F from E to F, and draw the morning hour lines. Those before six in the morning and after six in the evening are drawn by containing the same hour lines beyond the point C.

To set this dial truly, the plane of the dial must be horizontal and the stile fixed upon it in a vertical plane, and the line C A must be in the meridian. For the horizontal setting of the plane, and for the angle of the stile, a quadrant may be used. It is evident that no dial can be constructed if the latitude of the place be not known, we must also remember of the dial, *non nisi cœlesti radio.*

TO CONSTRUCT A MAKE-SHIFT QUADRANT.

From a point A on a flat board, or other thin but inflexible body, draw a line A B, and from this same point A another line perpendicular to A B. (by folding paper, if you have no better means). From A as a centre, describe the arc B C, which divide into 90 parts for degrees; suspend a weight by a string from the point A and your quadrant is made. If you stick two bits of card at the extremities of the edge C A, (tak-



ing care that this edge be parallel to A C,) and make holes in them, for sights, your quadrant will be very useful in taking angles of elevation or depression.

TO MAKE A SAND-GLASS, OR A CLEPSYDRA.

This dial is, of course, useless without the sun, but having one, for want of a watch, the traveller can profit by the presence of the sun, to construct a makeshift hour-glass. Take fine washed sand, and when quite dry, put it into a bottle, cover the neck of the bottle with a piece of bladder, in which make a small hole sufficient for the sand to fall gently through; observing now the indication of the dial, reverse the bottle over some receiver, and let the sand run out for an hour exactly, then stop it by reversing the bottle. Now put the sand run out into a phial that will just contain it, and close the neck by the same or some other piece of bladder, having a hole of exactly the same size, and the running out of this sand will measure one hour exactly. If it be required, however, to measure a longer time by this means, another bottle similar to that containing the sand should be reversed on it, neck to neck, and then fastened so that the bladder, or paper, or other covering, with the hole may serve as a diaphragm between them, so that the whole may be rapidly turned as in a common hour-glass.

The running of sand, it must be observed, is a much better measure of time than the dropping of water, for of the former, equal quantities run out in equal times, whatever be the height of the column of sand above, whereas in water, the rapidity of the running decreases as the pressure becomes less by a diminution in the height of the column. Nevertheless, as it may be more convenient in some cases to use a Clepsydra or water measure, it may be made in this way—

To construct a Clepsydra.—Take a vessel containing a sufficient quantity of water to serve for twelve or twenty-four hours, and make a small hole in the bottom of it, so that the water may fall in drops, place under this vessel another to receive the water, and after the water has flowed for half an hour by the dial, mark the height to which the water has risen in the lower vessel, do the same for the next half hour, and so on, and let these marks be numbered $\frac{1}{2}$, 1,

$1\frac{1}{2}$, 2, &c. The upper vessel, in the beginning of the operation, that is, every time it is filled, must be filled to the same height exactly. Observe also to place the Clepsydra out of the sun's direct rays, and out of the wind, so as to have as little error as possible from evaporation.

TO KNOW THE HOUR OF THE DAY OR NIGHT, HAVING NEITHER DIAL NOR WATCH NOR ANGULAR INSTRUMENT.

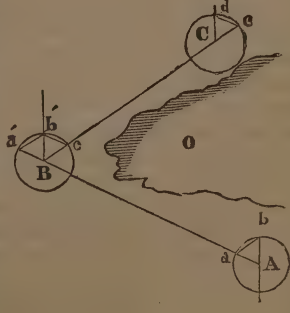
We know of no way of effecting this but by the knowledge of certain vegetable or other natural phenomena. Thus certain flowers open and close at stated hours, but these must be known, and only one at a time perhaps can be found in any one locality, and very often not even one.

TO FIND ONE'S WAY WITHOUT COMPASS.

Over a plain, by day.—Find the meridian line by one of the methods we have indicated ; draw a large circle on the ground, and divide it into sixteen or thirty-two parts, as may be requisite ; set up a staff in the direction you want to go, and observe what objects, such as tufts of grass, stones, trees, &c., lie in the exact line, and direct your course by them, as already explained. If no natural objects exist, set up staves, or place stones or men in the required direction. *By night*, mark the line by fires or by men with lights.

If any impassable object should occur, the direction may still be preserved by the following process :—

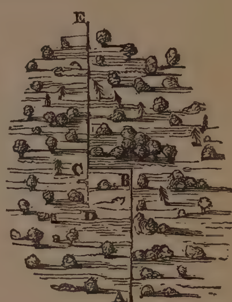
Having arrived at A, near the obstacle, plant a staff, and round it, as a centre, trace a circle of a given radius ; then direct a line towards B, and measure the chord *a b* ; arrived at B, where the object is cleared, set a staff in B, and round it trace a circle with the same radius as was used at A. On this circle measure from the continuation of the line A B, a chord *a′ b′*, equal to *a b*, and setting up a staff at *b′*, the line B *′b* will be in the same



direction as A b. If the point B is very far out of the direct line A b, you may get nearer the continuation of that line, by striking off in the line B c, after measuring the chord b' c. Arrived at C describe the circle as before, and from the continuation of C, mark off the chord c' d, and the line C d will be the direction in which to proceed.

It is strongly recommended in traversing extensive plains where there are no objects to serve as landmarks, to set up such, as you proceed, and at distances visible the one from the other, for then, if it be impossible to proceed, the shortest way back may be easily traced.

Through a wood.—To proceed in a given direction through a wood is no easy matter, and the difficulty increases with the thickness of the wood. The only way is to set up marks in the direction as far as they can be seen, that is to say, wherever in the line any two may be seen from a third; and when any trees intervene, proceed thus:—Suppose A B to be the direction interrupted by the tree at B; look to the right and left where you can see farthest. Suppose it to be on the left at C, three steps from B; set up a mark there and one behind it at D, also at three paces from the line A B, then proceed in the direction D C on to E, or till some other interruption, when the same process must be repeated. Note always how many paces have been taken to the right or left, and cancelling them as often as possible by taking alternately on either side, as far as it can be done. This process is exceedingly slow, but there is no better that we know of, when deprived of a compass. If the traveller have a watch, he may know his direction at noonday by the shadows, but this will only serve him as a rectification of his route. Little can be learned in a thick wood of the points of the compass, by observing the trunks of the trees, for they are too sheltered from the effects of prevailing winds to afford any indications, an experienced eye, however, may discern a general inclination of the tops of the trees, occasioned by the prevailing winds, and this sometimes affords a good clue to following a particular course through a forest.



In going into a wood, it is recommended either to break branches off the underwood, or twist them, or make some other marks by which you may retrace your steps.

In a cavern, or intricate subterranean passage.—The grand object of solicitude on entering a cavern or subterranean passage is to be able to find the way out again. For this purpose a clue of strong cord, and of sufficient length should be provided. When, after entering, you begin to lose the daylight, then fasten one end of your line firmly to some large stone or otherwise, in such manner that it may not slip, and unwind as you proceed; but as the line may by some accident get broken, or be maliciously detached, so as to render it useless as a means of extrication, other marks should be made. Thus marks of this form ∠ may be made on the walls of the cavern or passage by the smoke of the candles or torches, the point showing the direction in which to proceed *on returning*, remembering also to place the marks so that one may always be seen from another; or three stones may be placed in a line on the ground, every here and there; or, if the soil be soft and no stones are to be found, scratch a line on the ground. At the top and bottom of every precipitous descent which you have to pass, a distinct mark should also be made, and also at the angles of every turn. It need hardly be recommended to provide matches of some sort or other, or flint and steel, &c., for obtaining a light.

TO CLIMB TREES.

It is often necessary for travellers to climb trees, either for looking round, or to pass the night in security from wild beasts, or for concealment, &c. Hence the following instructions may be acceptable. If the trees have no branches, such as palm-trees, they may be climbed with comparative ease, by the following process.—Take a strip of linen or two towels, or strong handkerchiefs tied together, and form a loop at each end for the feet to pass tight into without going through; or for want of such material make a rope of grass or straw in the same way. The length should be such as to embrace a little more than half of the diameter of the trunk to be climbed (palm trees are seldom of great girth). Now, being at the foot of the tree, fix the feet tight into the

loops, and opening the legs a little, embrace the tree as high up as you can; raise your legs, then pressing the cord against the tree with your feet, stand, as it were, in your stirrups, and raise your body and arms higher; hold fast again by the arms, open the legs again, and raise them a stage higher, and so on to the top. The descent is effected in the same way, reversing, of course, the order of the movements. The ruggedness of the bark and the weight of the body pressing diagonally across the trunk of the tree, prevent the rope from slipping. Anything, provided it be strong enough, is better than a *round* rope, which does not hold so fast. A little practice will soon render perfectly easy, this mode of climbing.

Trees having branches, but of which the lowest is of considerable height, may be ascended thus:—Having a strong rope, at least twice as long as the branch to be reached is high, keep one end in the hand, and by means of a stone tied to the other end, throw this over the branch; or if it be too high and you have the means, fasten a long twine to an arrow, and shoot it over the branch, then fastening one end of your rope to this twine, draw it over the branch. Now fasten to one end of it firmly so as not to slip, a strong stick, about two feet long, with a notch in the middle. Seat yourself across this stick, so as to have the rope come up from between your legs in front of you; now seize the other end of the rope above your head, and draw yourself up. This mode, though extremely simple, requires a little practice, as by pulling too hard, or leaning back, the legs are tilted up, and the climber comes to the ground.

TO CLIMB OR DESCEND PRECIPICES, &c.

The mode just indicated may be sometimes employed for ascending and descending precipices, if they be studded, as is often the case, with projecting trees. The descent, particularly, may often be rendered easily practicable by this

means, when it would otherwise be impossible, and escape from confinement may sometimes be effected, in this way. In all cases, the rope should be of sufficient strength, and the object round which it is thrown, and against which it rubs, must not be angular and sharp. Rounded and weather-worn, but solid rock, will do, but angular or splintery rocks will not.

TO PASS A ROPE OVER AN ELEVATED OR TO A DISTANT OBJECT.

It not unfrequently happens that an object over, or to which, the traveller would pass a rope, is too high or too distant for him to throw it. In this case he must employ his ingenuity. Thus a stone may be thrown a great way by means of a sling, than which, nothing is easier to construct. Let then, a long twine be coiled upon the ground, having one end fastened to the rope to be passed, and the other end made fast to the stone thrown by the sling. Or without a sling, fasten a stone to one end of the twine, and turning it a few times, so as to communicate a sufficient centrifugal force, hurl it from you. If the object be vertical and the base accessible, you will get back the stone end, which will come down by its own weight, if you let out the coil. If the object be distant and inaccessible, some other person must be at the place to seize the twine, and by its means pull the rope over. We need hardly say that thicker ropes may successively be bent on, and passed over if needful. An arrow shot from a bow may be also used to pass a twine to the top of a precipice or tower, across a stream, a small river, &c. A kite, if the wind be favourable, answers very well, and may be immediately made with a newspaper, or a square of *glazed* linen, &c., and two cross reeds, cane, or slips of wood. When we say that in order to employ a kite, the wind should be favourable, we do not mean that it is required to blow exactly in the direction we want to send the kite, for by means of two belly-bands, at right angles to each other, the kite may be so braced as to go many points from the wind.

TO JUMP WIDE DITCHES.

Very wide ditches or small streams, may sometimes be passed by using a long pole, this is held in the hands and near the top, the right hand uppermost. A short run is then taken, and upon coming near the brink, the lower end of the pole is directed to the middle of the ditch, while he who holds it firmly, springs at the same instant upwards and forwards, by which he is carried over in an arc of a circle, of which the pole is the radius. To be dexterous at this feat requires some practice. The Dutch are great adepts at this.

TO SEEK FOR FORDS.

Fords must always be sought in the widest part of a river, or in the diagonal line that joins the salient angle of one side of the stream, to the salient angle of the other side, and not from the salient angle of one side, to the opposite re-entering angle. Fords for persons on foot, should not exceed three feet, and for horses four feet, for camels five feet. These are the extreme depths, and if the current be strong, one foot should be deducted from these depths. When a large caravan has to pass a ford, it is sometimes found to be practicable only for the first that go over ; for these stir up the bottom, and the sand so moved is carried away, and the ford deepened, so as to be no longer passable.

TO PASS RIVERS.

The obstruction of a river is always a serious impediment to the progress of travellers, whether they be wandering alone, or be in a large or small party, and here we cannot help observing how very necessary it is that every traveller should be a good swimmer. But though the traveller may be able to swim, it may be of importance to him to secure his papers, his watch, or instruments, his gun and powder, and even his clothes from wet. He must therefore, construct a little raft of branches, or reeds, or anything floatable he can get, and on this erect securely a little stage, on which to put his clothes, papers, &c., and by means of twisted

twigs or otherwise, for want of a rope, drag his raft after him while swimming over. When there is a party they are probably provided with many objects which may help them in the construction of a raft to carry all across. In swimming a river with a horse, the better plan is to lie in the water, and holding tight by the lower part of the mane with the left hand, allow the horse to drag you along, keeping the body stretched out straight, and assisting yourself with the movement of the right hand and arm. The cowherd of the Nile crosses this stream, seated on a bundle of straw and dragged across by his swimming cow, of which he holds the tail. Sometimes this river is crossed on a raft of inverted earthen pots, or on an inflated goat's hide. In tropical countries, where sharks or crocodiles, or other dangerous animals inhabit the water, the crossing on a raft should always be preferred, if practicable, to swimming. Crossing astride on a rounded log is always hazardous for one who cannot swim, for it is very apt to roll. This inconvenience is avoided by fastening two logs together, in a parallel direction. It may be observed that as the specific gravity of the human body is not very different from that of water, a very little is required to bear the body up. A string of small faggots or rushes, fastened round the body under the arms, is quite sufficient.

OF SIGNALS BY SIGHT OR SOUND, NIGHT AND DAY.

It is often necessary to make signals; this may be done in a variety of ways and applied to a variety of purposes. Travellers are sometimes so circumstanced, as to have occasion to communicate resolutions in presence of their enemies, which it would be unsafe to do by word of mouth, lest they should be understood. Preconcerted signals should therefore be agreed upon, of a kind easily understood by the party, and which shall create no suspicion, as particular positions of the fingers, the hands, the arms, the feet, and legs. These positions may be taken with apparent unconcern, and as if accidental, scratching or rubbing some particular part of the face or body with one or the other hand, with one or other finger, and in all cases there must be an answer signal to show that the one made has been understood. Signals to convey intelligence at a distance, may be made by sight or sound; with regard to sight for day signals, men may be

placed at such a distance as to see each other's movements distinctly, and then, by the positions of the arms, convey intelligence very quickly to a distance so much the greater as the number of men is greater. Each arm may be placed in four different positions \ — / | Thus you have eight signals, and by using both arms together, a combination of sixteen more may be obtained. These twenty-four signals are sufficient for communicating everything important; it being understood that such a telegraph is only established for a particular purpose, none but the first and last person need understand the signals, the intermediate individuals being only repeaters; or, in this case, mere machines. A similar system may be adopted at night by means of lanterns, with this advantage, that as the lights may be seen at a great distance, fewer men are required, or, what is the same thing, the same number of men can convey the intelligence much further. Be it observed, however, that as the position of the arms cannot be distinguished at night, it will not do to apply the system of the same signals with a lantern in each hand, for at night, all but five of the twenty-four arm signals would be confounded. It is therefore necessary with lanterns to have a bar of wood fixed to an upright pole, in such a way that the bar may revolve upon its centre in a vertical plane; now four different positions may be given to this bar, and by a combination of four lamps, forty-seven signals may be made. The plan might also be adopted in the day time by suspending in the same way, balls of grass, or bundles of dark twigs, &c. As for the lanterns, the number required would be greater than travellers usually have with them, and generally speaking, there are few occasions where such a telegraph is required: mostly a single signal is all that is required for some special purpose, and this will be different according to the distance, and whether it be day or night. A black kite, or a kite with a dark-coloured handkerchief at the tail may be set up for a day signal, and a kite with a lantern at the tail for a night signal. The writer once set up a kite in a dark night with two port fires spliced into one, and a slow match fixed to the tail; when at a great height, it took fire and burned twenty minutes like a most brilliant meteor, which was noticed by many persons several miles off. Rockets are easily made, and are a good night signal, but it is necessary to keep a good look out for them, or they may be unseen. The same may be said of the kite, but then it burns much longer, in all cases we repeat, the signal must

be answered. For shorter distances, the firing of muskets or pistols may be used, or the ringing of a bell, &c. While speaking of signals we cannot help reminding the reader of a signal once employed with success, in we forget what battle, we think the battle of Fleurus, of mechanically turning the sails of a windmill in a direction contrary to the natural one, it was of course preconcerted and escaped the notice of all but the parties concerned. We cannot close this article on signals, which many may, perhaps, think superfluous, without recommending all travellers to be provided with a small shrill whistle or a horn, by which signals of recognition or assembly may be given in the dark, or in wandering through woods or over mountains.

TO SEEK FOR FRESH WATER, AND TO OBTAIN IT.

There is nothing, perhaps, more essential to the traveller than to procure potable water. In cultivated plains, water is, of course, always to be had, and in mountain districts it may generally be procured by looking for; though all kinds of mountains are not alike in this particular. Thus, in primitive soils or granite rocks, &c., there will be found many, but small springs, and their waters pure, limpid and wholesome. In secondary limestone countries, on the contrary, springs will be more rarely met with, but those which exist, will be found to be very abundant, and their waters, though limpid, less pure and wholesome, by reason of a portion of dissolved lime, and, probably, other mineral matter with which calcareous formations sometimes abound. In stratified rocks, springs should be looked for on the side towards which the strata dip ; but it is chiefly in barren, sandy tracts, that the want of water is most keenly felt, and that this essential article is most difficultly obtained. In such places, water must be sought wherever there is an appearance of vegetation, though this does not always prove the existence of water, as certain plants require no more moisture than what is supplied to them by the circumambient air. At other times, however, though no water be visible, it may be found where there is vegetation by digging. We need hardly say that it is more likely to be met with in hollows than elsewhere, and at a less depth below the soil at the edges of a plain, than nearer its centre. Water, though found, is not always drinkable. In such cases it may sometimes be distilled by a

simple adaptation of pots, so as to form an alembic, or with a single pot, by stretching over it a cloth to imbibe the steam, and wringing this out. The quantity thus procured will of course not be great, but a few mouthfuls of drinkable water is all that is required to sustain the failing strength of the nearly-exhausted traveller. Very pure water may sometimes be obtained by collecting the dew in a large oil skin or waxed cloth, stretched out for the purpose on the ground, and somewhat raised at the corners, so as to have a concave surface. Rain water may be caught in the same way; or, what is still better for rain water, stretch a large permeable cloth, but rather loosely, by the four corners, fastening them to four poles; place a stone or other heavy body in the centre of the cloth, which will draw this centre downwards in a point; below this centre place a vessel to receive the water. All the rain which falls on the cloth will run down to the centre, and fall thence in a stream into the receiver. An umbrella reversed will catch water enough into a vessel to satisfy one or more persons according to the duration of the shower.

TO CLARIFY FOUL OR TURBID WATER.

The great impurity of the water frequently met with by travellers, is one of the most distressing circumstances to which they are exposed. When water is salt or bitter, or rendered disagreeable by any soluble substances it may contain, there is no other way of rendering it palatable than by distillation, a process which, in some cases, may be resorted to, though very rarely, because the process is slow, and even in its simplest form, that of a pot and a cloth, as we have already stated, or of a tea kettle and a bottle, cannot always be performed, for want of even such apparatus. Impurities, mechanically suspended, may be in part got rid of by filtration through linen, and this will do very well sometimes, but when a rather numerous party, or caravan, is encamped for some hours or days near a muddy pool, the following method for having clear water may be adopted.

Take a cask or a box, perforate the bottom and the sides to the height of three or four inches, with a great number of holes of about a quarter of an inch diameter. Place in the

bottom a layer of straw, or grass, or moss, or twigs, or tow, or any thing of like kind, so as to cover all the holes of the sides and bottom without stopping them up, then throw in a layer of sand, if any can be had clean near the spot, if not, it must be cleansed by washing. Over the sand place another layer of straw, &c., and keep all down with sticks and stones. Place the cask or box thus prepared, in a pool within two or three inches of the upper edge, and to this height the water will rise in the box, clarified by its passage through the sand, and any quantity taken out is almost immediately replaced. Care must be taken that the bottom of the cask or box do not rest on the muddy bottom of the pool or river, for this would close the holes. If the party be very large, several boxes may be thus prepared. The holes made in the boxes will not unfit them for the carriage of many objects, and they may be repeatedly used for the purpose just stated. Or place in the muddy water a close-textured bag, keeping it stretched open by means of hoops or cross sticks, and fixing it in its place by stakes.

A small piece of alum thrown into troubled water will clarify a very large jar of it in a very short time, as is well known in India, where it is a common practice. Some fetid waters are much improved by being boiled before they are drank.

TO KINDLE A FIRE.

To obtain a fire is often as necessary to the traveller as to obtain water, and is sometimes as difficult. A fire may be kindled by a variety of means, as with instantaneous light matches of various sorts; by means of flint and steel, with tinder and a common sulphur match; by igniting gunpowder; by the use of a common lens or a metallic reflector; by percussion, compression and friction; by chemical combustion, &c.

Of the instantaneous light matches, whether Lucifers or Congreves, nothing need be said but that they are, particularly the latter, invaluable to the traveller; he should therefore be always provided with them; they must be kept very dry or they will not ignite; care must also be taken in travelling, so to pack them that they be subjected to no friction, otherwise they may take fire and do much damage. The tinder used with flint and steel, is prepared by burning

old rags and smothering them before they are burnt to an ash ; but unless sulphur matches are at hand, or sulphur to make them with, it is needless to make tinder. Flint and steel may be used with a piece of *amadou** as is well known to all smokers. As most travellers are armed, the use of a little gunpowder is, perhaps, the readiest way to obtain a fire, if he have no instantaneous light matches. When the sun is out and powerful, a lens or a reflector may be used with advantage in kindling a fire ; it may be remarked that the darker the colour of the substance to be ignited by this means, the readier it takes fire. It is said that a blacksmith can make a piece of iron red hot by hammering it on his anvil ; but, allowing the fact, the traveller has neither the blacksmith's dexterity at this feat, nor generally, the instruments at hand. The air-syringe is a well-known toy ; if a piece of *amadou* be placed under the piston of this instrument it will ignite. Friction, it is well known, produces heat, and savages are in the habit of kindling fires by this means. Two pieces of hard dry wood are rubbed together till they emit sparks or flame ; or the point of a piece of hard dry wood is thrust into a hole purposely made in another piece of dry wood, and the former is then made to revolve quickly by rolling it between the hands ; dry leaves and other easily combustible matters are heaped round the point of friction to take fire readily. A great many chemical combinations extremely simple produce instantaneous combustion ; but simple as they are, the traveller seldom carries with him the requisite ingredients.

TO ASCERTAIN THE BREADTH, DEPTH, AND SLOPE OF THE BED OF A RIVER.

By the bed of a river we mean that part of its channel which is habitually under water. The breadth of this bed is, properly speaking, the breadth of the river, though this is sometimes taken from bank to bank, which often exceeds the ordinary width of the stream. The *breadth* of the bed, then, may be taken by any of the methods we have already pointed out.

* *Amadou* is a species of Fungus called *Boletus Igniarius.* This is beaten into flat pieces, then dried, then steeped in a solution of nitre and dried.

The *depth* of the bed must be taken by soundings right across, at short intervals, say every hundred yards. These soundings will show, at the same time, the *slope* of the bed which is, be it remarked, a very different thing from the slope of the surface of the stream. This latter may be taken by means of any convenient and portable level, setting it up always, close to the water's edge.

TO ASCERTAIN THE VELOCITY OF A RIVER.

It is necessary to observe that the velocity at the surface is different from that of the mass; but as the former must be known before the latter can be computed, we shall first indicate the different means by which the former may be ascertained.

Surface Velocity of a River.—1st. By means of the common log or its substitute as indicated at the article *log* in section INSTRUMENTS.*

2dly. By the following method. Choose as straight a part of the river as possible.

At a, plant a stick in the ground, and, retiring half a dozen paces back, plant another stick at c, in such manner that the line a c may be as perpendicular as possible to the direction of the current, and that from two or three paces behind c, the middle of the stream may be easily seen. From a, measure along the bank as many times 51 feet (strictly 50 feet 11 inches,) as may be convenient, and place another stick,

* The log, from the very small portion of it which rises out of the water, will be found particularly convenient whenever you can have a boat or raft anchored in the stream.

say at b, and behind this a fourth stick, d, making b d like a c, perpendicular to the course of the stream. The distance of c from a, and of d from b, is quite arbitrary, nor need it be alike at the two stations ; a little, more or less, is of no consequence, so that the lines they form be perpendicular to the line of the current and parallel to each other, and that the middle of the stream may be seen from behind the hindmost.

This done, if you have an assistant, let him go a little above the station a and throw into the *middle of the stream*, if this be possible,* a ball of wood so balanced by lead as to float just above the surface ; or, for want of this, any piece of wood, bark, or other thing which will float ; remembering only that the less it rises above the surface of the water the better, for, even in a calm, its motion is impeded by the resistance of the air, and if there be wind, it tends alike, from whatever quarter it blows, to give an enormous result.† While your assistant is going about this, station yourself behind *d* ; then take out your watch and be ready. Your assistant having thrown in the float, runs down to his place behind c, to wait for its passage : when he sees it coming near he must raise up his arm at full stretch, on seeing which you stop the seconds hand of your stop watch, keeping your nail on the catch. The moment the float passes the line c b, the assistant drops his hand, and at the same instant you touch the catch and let go the seconds hand of your watch,

* When a river is wide, it is no easy matter to throw any thing exactly into the middle of the stream, or to see it floating there, if small. In this case, if a bend can be found at no great distance above, as at e, the float should be there thrown in, as at such places the mid current, or *fil de l'eau*, as the French term it, hugs or approaches the re-entering bank. In all cases it must be stated whether the rapidity observed, be that at the middle of the stream or not, for the difference is very great between that in the middle and that near the banks ; the latter being incomparably slower, and so much the more so as the banks are more shelving.

† The best kind of float is, perhaps, that which was used by General Destram on the Neva, but it requires conveniences which a traveller cannot always command. It consists of a cylindrical disc of cork, one inch thick and one foot in diameter, and lined with sheet lead, so as its upper surface may just be even with the surface of the water ; from the centre of this disc rises a slight copper stem surmounted by a little ball of cork painted white. This may be seen at a distance, is little affected by the wind, and the small thickness of the disc prevents its motion being affected by the less rapidity of the deeper fillets of the stream.—See *Journal des Voies de Communications.* No. 2. St. Petersburgh, 1826.

keeping your nail at the catch ready to stop the watch again; you observe, in your turn, the passage of the float past b d, when you stop the watch, and count the seconds elapsed during the passage of the float from a to b. Now multiply 30 by the number of times you have taken 51 feet in your line from a to b, and divide by the number of seconds elapsed, and the quotient will be the velocity of the stream, expressed in nautical miles to the hour. Example, suppose you had measured 255 feet from a to b, or 5 times 51 feet, and the seconds elapsed, as marked by the stop watch, had been 40. Then,

$$\frac{30 \times 5}{40} = 3\tfrac{3}{4} \text{ geographical miles per hour.}$$

Velocity of the Mass of Water.—The surface velocity being obtained by any of the methods above stated, the velocity of the mass of moving water may be found with sufficient accuracy for all practical purposes by the following rule.

From the square root of the velocity at the surface take 1, square the remainder, add this square to the velocity at the surface, and take half the sum, so that if S be the velocity at the surface, and Y that of the mass, the formula will stand thus:—

$$Y = \frac{(\sqrt{S}-1)^2 + S}{2}*$$

* There are other formulæ for ascertaining the mean velocity of the mass. Thus, knowing the slope and the section of the bed, proceed thus, a being the section of the channel, p the periphery of the channel, l the length of course in which the slope h has been observed, and x the mean velocity sought, say—

$$x = 90{,}9\frac{\sqrt{ah.}}{pl.}$$

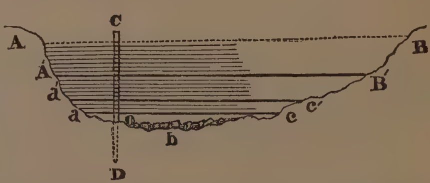
This formula is by Etelwein, and is consigned in the memoirs of the Acad. of Berlin. Whatever formula be adopted, however, nothing but an approximation to truth can possibly be obtained. Those, however, who wish, for particular purposes, to calculate with the greatest possible accuracy, may consult Bellidor, Prony, and other Engineers.

TO FIND THE QUANTITY OF WATER DISCHARGED BY A RIVER, AT A GIVEN POINT IN A GIVEN TIME.

In order to ascertain the quantity of water discharged by a river, at any given point of its course in a given time, it is only necessary to multiply the section at the particular place, by the rapidity of the mass at the same place. Having already detailed the operation by which the rapidity of the mass is found, it remains to explain how the section of the river is to be obtained.

Having chosen a convenient spot for the purpose, drive down into the bed of the river a squared post, which must be sufficiently long to rise above the greatest height to which the water ever rises. Form this into a scale, beginning at, or even below the lowest observed water-mark, and indicating every rise of six inches, by white lines on a black ground, or black lines on a white ground with corresponding number, at every foot.

This done, measure with the greatest possible accuracy the transverse section of the river passing through the post, and formed by a vertical plane, perpendicular to the direction of the stream, the superior limit of which section must be a horizontal line passing through the top of the post. Lay this section carefully down on paper, by scale, and as large as possible.



Having done this, let fall, as in the figure, the line C D, perpendicular to A B, the superior limit of the section, and at a height O from the bottom of the bed, mark the zero point somewhat below the lowest observed water-mark: from this zero point, taking six inches from your scale, graduate upward to the extreme limit of the post. Now measure as nearly as possible the *square surface* of the lowest section, or a b c, and successively all the sections, as they increase in height by six inches at a time, till you arrive at the greatest section A b B.*

* The lines A′ B′ and a′ c′ in the figure, are supposed to represent the ordinary high and low water marks.

These areas of the different sections must now be entered in the second column of a table like the following:—

Height of water at the post.	Areas of sections in square feet.	Velocity, feet in a second.	Discharge of water in cubic feet in a second.	Remarks.
ft. in.				
0 — 6	..	..	..	
1 —	..	..	..	
1 — 6	..	..	..	
2 —	..	..	..	
2 — 6	..	..	..	
3 —	..	..	..	
3 — 6	..	..	..	
&c.	..	..	..	

Every thing being thus arranged, the velocity of the mass must be observed at all the different heights, as occasion offers, and the results placed in the third column, when the multiplication of the numbers of the second and third columns, will furnish the result to be consigned in the fourth.

A circumstance which it is very important to observe is, that the velocity, and consequently the discharge, is not always the same for the same height of water. Thus, in the vicinity of the embouchure into large lakes, or inland seas without tides, the direction of the wind, by impeding the flowing off of the waters, causes them to rise, and sometimes even drives them back to overflowing, as is the case with the Neva, at St. Petersburg. Sometimes the increased rapidity and volume of water of a large recipient swells up the water of an affluent. Care must be taken to notice these circumstances, so as not to confound such accidental rise, with that occasioned by an increase in the quantity of water flowing down.

Now, supposing the stream to flow equably, it is evident that, by multiplying the numbers of the fourth column by sixty, the product will be the quantity of water which flows off in a minute, and this again by sixty, the discharge of an hour; this again by twenty-four, the daily discharge, and so on.

But as few rivers have this regularity, it is best to observe at least three times a day, from the medium of which obser-

vations will be calculated the discharge of the day. When once the discharge at all the different heights of section shall have been obtained, it will be sufficient just to remark the height of the water, and then insert the corresponding discharge in the morning, at noon, and in the evening of each day, as in the following table, the mean of which will be the mean discharge for that day. Thus,

DISCHARGE OF THE WATER OF ———, MONTH OF ———.

Date.	Observed discharge in cubic feet.			Mean daily discharge.	Remarks.
	Morning.	Noon.	Evening.		
1	..	..	..	..	
2	..	..	..	..	
3	..	..	..	..	
4	..	..	..	..	
&c.	..	..	..	..	

The addition of the means will give the whole discharge for the month.

It is evident, that by this plan, an approximate estimation of the discharge of the river at any particular place so long as the bed remains surcharged, may be obtained by the second, the minute, the hour, the day, the month, or the year, and for any number of years, &c.

TO ASCERTAIN THE QUANTITY OF SOLID MATTER HELD IN SUSPENSION BY RUNNING WATER.

To judge of the solid matter held in suspension by running water, and thus conveyed from one place to be eventually deposited in another, would be a very easy task, if the particles were all of equal size, and the stream equally rapid in all parts, for then it would be sufficient to take up, from the immediate surface, a given measure of the troubled water, and, separating the solid particles by filtration or by subsidence, measure the residuum. But two causes con-

tribute to render the result of such a method erroneous, the difference in the size and weight of the particles of suspended matter, and the different velocities of the stream at different depths, at different distances from the banks, and in different parts of the river's course. The fact, therefore, is, that the proportion of matter carried along by the water is different at different places, and at different depths. The most rapid part of the current being a little below the surface, and in the deeper part of the stream, it is also there where the greater proportion of suspended matter will be found; but this will be different in different parts of the river's course. Thus it is impossible to say from one, or even a few experiments, made in different places, that the river, generally speaking, carries along such or such a proportion of detrital matter; for from the separate data no medium can be taken; each case is a fact in itself, unconnected with every other. Thus in the river A B, experiments made at the points a, b, c, will give different results; say at a, 1-100th; at b, 1-500th, and at c, 1-350th.

Now we must neither take the sum of these quantities nor the mean, the water at a, is very thick and troubled, coming immediately from the torrents near the source. But the bends of the river between a and b, are such that the rapidity of the stream is greatly impeded, so that at b the water contains only 1-500th of sedimentary matter. If no fresh detritus were stirred up or brought into the river, a still smaller proportion would be formed at c; but either because the soil from b to c is of easy erosion in the floods, or because the stream e brings in a quantity of mud or

sand, the water at c is found to bear along 1-350th part of detrital matter, the greater part of which is deposited at the bank d.

In estimating, therefore, the quantity of sedimentary matter carried along by streams, with a view to form some idea of the progress of alluvial deposits (the only object for which such estimate is made), the experiment should invariably be made as near as possible to the spot at which the alluvial deposit is an object of interest. If it had so happened, that a lake had intervened between that part of the Yellow River of China, when Sir George Staunton made his experiments, and the sea, so far from bringing into the Yellow Sea, forty-eight millions of cubic feet of earthy matter, that river might not have brought in any; or if, without a lake, the course had been long or very winding, the quantity might have been less; or if, in that length of course, other turbid waters were received, the quantity would have been greater.

Mr. Lyall, in treating of this subject, proposes taking the weight of the sedimentary matter obtained in the experiment, and then, from the difference of the specific gravity between the water and the sedimentary matter, deducing the bulk of the latter; but the readier manner is to compare the bulks at once.

Thus, take up from different places, in a line across a proper part of the stream, a given measure of the turbid water, and having allowed it to subside, draw off the clear water, and dry the precipitate. In the case of a very fine clay, which requires a long time to settle completely, the last water must be driven off by artificial heat. Measure the dried mass, and compare its bulk with that of the turbid water taken up. Any cylindrical vessel will do for the experiment, by merely dividing it into equal parts, or by measuring the height of the liquid with a rule or stick divided into equal parts, say tenths of an inch, and subsequently putting the dried precipitate into the same vessel, and observing its height with the same rule or stick. The dried precipitate must, of course, be brought to as horizontal a surface as possible in the vessel before the rule be stuck into it, and the rule must be as thin as possible, in order not to displace any notable quantity either of water or sediment.

It will be found that the quantity urged along in the deep part of the current, is greater than that carried forward in the more shallow parts; the latter will also be finer, the

medium of these in the same cross section must be taken; and when the absolute quantity of turbid water which passes the place in a given time is known, the quantity of solid matter carried into the sea or into a lake or other recipient, to be there deposited, is easily computed, with an approximation to truth, sufficient for the purposes intended.

If it be deemed necessary to observe the quantity and kind of sedimentary matter borne along by the current at *different depths below the surface*, it will be necessary to employ some one or other of the instruments that have been invented for bringing up water from places below the surface.—*See* INSTRUMENTS.

TO OBSERVE THE TEMPERATURE OF THE AIR.

As one of the chief elements of climate, on which so much depends, is the temperature of the air, the traveller should lose no opportunity of observing it. The hours of observation should be, if possible, the same each day; those recommended by the committee of the Royal Society are 3 A. M., 9 A. M., 3 P. M., and 9 P. M. These hours will not, of course, correspond with any determined time elsewhere, by reason of the traveller's continual change of place; and the uncertainty of his longitude prevents his making any calculations of time, by which he might observe at hours corresponding with those appointed for the established observatories; unless indeed he have a chronometer, of which he has ascertained the rate, and which is set to the time at one of them. Be this as it may, the traveller who is provided with the requisite instruments, and happens to be stationary on the days of the equinoxes and solstices, or on the days immediately preceding or following them, is recommended, if possible, to make hourly observations from 6 A. M. of the appointed days to 6 A. M. of the days following; observing at the commencement of each hour. These days are also recommended for observing on the tops of high mountains. It is also desirable that the temperature at 3 A.M. on the days of new and full moon and quadratures should be noted.

These recommendations apply to barometrical and all other meteorological observations; but a traveller cannot be expected to conform rigorously to them, and they are accordingly mentioned here, merely that he may know what is

desirable and therefore do what he can, as opportunities occur. Regular observations can be made only at stationary observatories, and such are amply supplied with instruments and instructions.

In order to observe the temperature of the air, the thermometers, both ordinary and register, should be suspended in the shade, out of the way of reflected sunbeams and reverberated heat, and protected from rain, and not be in immediate contact with any wall. In reading them the observer should avoid touching, breathing on, or in any way warming them by near approach of his person, and in night observations, particular care should be taken not to heat them by bringing a light near them ; the quicker the reading is done the better.*

For observing the thermometer at night the following plan may be adopted. Put a bit of phosphorus into a small phial, then fill it one third with boiling olive oil, and cork it close ; whenever the stopper is taken out at night sufficient light, without any heat, will be evolved to read off the indications of the thermometer.

The temperature of the air depends upon so many different circumstances, that little real information can be gleaned from stating the indications of the thermometer, unless the principal circumstances of each locality be mentioned. We recommend that the thermometer be invariably held or suspended at a certain height above the soil ; for a difference in this respect, when all other circumstances are the same, will give a different result. This precaution being attended to, the peculiarities of the locality should be stated in the column of remarks. The temperature in the open fields and that in a wood close by, will be found to be very different. The temperature in a pine wood and that in a wood of deciduous trees will, under circumstances exactly similar, be seen to differ greatly ; and, in the open air, the temperature will be different, according as the soil is bare or covered with vegetation ; and a difference in the nature and colour of naked soil, and a difference in the nature of vegetation, induces corresponding modifications in the temperature of the air above them. Valleys, in all other respects similar, that is, being of equal dimensions, bounded by hills of like nature and equal height, &c., will have different temperatures according as they open to this or that particular point

* See Report of the Committee of Physics of the R. S.

of the heavens. Hence the necessity of noting the precise locality, whenever an observation of the temperature of the air is made ; and hence also we perceive how desirable it is to make, with well compared thermometers, corresponding observations, in order to ascertain, as far as possible, the influence of locality on the temperature of the air. And here we cannot help particularly recommending to the traveller to observe the heat reverberated horizontally from steep rocky acclivities ; that is to say, the distance to which it is appreciable horizontally, and the amount of its influence. This may be very speedily done, if the traveller have several thermometers ; but if he have only two, the observation will require some days to be exactly performed. In the first case, thermometers must be placed in a line at regular distances from the reverberating surface ; the line being, as nearly as possible, that in which their own shadows would fall at the time of observation, which should be when the sun's rays impinge the most perpendicularly on the reverberating surface. When two instruments only can be used, different distances must be taken with them on different days.

It is observed that cold air not unfrequently comes down the mountain sides at night. It would be very interesting to note the extent of this phenomenon, that is, the temperature of the cold current and the distance at which it is felt. This might, under favourable circumstances, be effected by a line of minima register thermometers properly disposed.

We will now merely add, that the traveller should always have at least one of his thermometers about his person, to take the temperature of the air at all times and in all places ; in houses, in caverns, in fogs, during rain, or snow or hail, in fine weather, on hills and in valleys, in woods and in the open country, at morning, noon, and night ; he will also frequently require it to take the temperatures of the waters he may meet with.

TO TAKE THE TEMPERATURE OF SPRINGS.

The traveller should never pass a spring without taking its temperature, if this be possible. We recommend his plunging the whole instrument into the water, and holding it there till it has taken the temperature, then draw it out sufficiently to read off, after which dip it in again, and repeat the operation three times at least, and if there be any difference in the

reading, take the mean of the three observations. Wipe the instrument carefully before putting it back into its case. The temperature of springs should be taken as close as possible to the very point where they issue from the earth. The temperature of the air in the shade must be taken at the same time. The object of plunging the whole instrument in the water is, to save time, and have greater accuracy. Care must be taken, however, not to plunge suddenly a thermometer which is very warm into an ice cold spring. In taking the temperature of mineral springs, the thermometer should be put into a glass tube, otherwise, the metal mounting may be corroded;* but when a tube is used, longer time is, of course, required to get the temperature.

In taking the temperature of springs, it is necessary to note their position and aspect, and the nature of the rock or soil whence they issue.

TO TAKE THE TEMPERATURE OF RIVERS, OF LAKES, OF THE SEA, AND OF WELLS.

The temperature of the surface water of rivers should be taken in the same way as pointed out for springs; but when it is required to take the temperature of the water at depths below the surface, the operation must be conducted differently, and with appropriate instruments. Thermometers prepared as we have mentioned, sect. *Instruments*, may be employed; but as the bulbs of such thermometers are surrounded with bad conductors, time is required before the instruments can take the temperature of the medium in which they are placed. Where such thermometers are used, the time required for the instrument to take the temperature should be known beforehand, so as not to leave it longer in the water than is necessary; and whenever a thermometer is to be prepared for any particular case, the quantity of bad conducting substance with which the bulb is to be surrounded should be so proportioned, that the time required for the instrument, when prepared, to take the temperature, should just exceed by a few minutes the time required in drawing it up; so that the temperature at the required depth may be ascertained with as little loss of time as possible. The instrument must be left down a little more than the time required for its taking the temperature of the medium, and

* Thermometers graduated on the glass stem, or having a glass scale are the best for such cases.

when brought up, this should be done quickly but steadily, and the indication read off immediately.

Another way of proceeding is by employing the instrument described in the sect. *Instruments* for drawing up water from a depth. We strongly recommend an adjustment for fixing the thermometer into the tube before letting it down, as by this means, a more correct result will be obtained; but if this be not done, the ordinary thermometer must be plunged into the water, the moment it is brought up. Register thermometers have been recommended, but the writer has universally found the indexes to be deranged by the motion of the currents in running water, and, in still water, by the drawing up of the instrument, however carefully done. If the depth be not very great, three observations at least, should be made and the mean taken. In running waters, the line to which the instrument is attached, however much it may be leaded, will not be vertical even if the bottom be reached, and consequently an allowance must be made according to the angle or the curve which the current forces the line to make.

These observations apply alike to the temperature of the sea, of lakes, and of wells. In all cases, the temperature of the air should be taken at the same time. It must also be remembered that the temperature at great depths in rivers, lakes, and the sea, is interesting only as compared with the temperature at the surface, which should therefore be observed at the same time. The depths recommended at sea are 150 and 300 fathoms.

We may here add that interesting observations may be made on the difference of temperature induced by cataracts, cascades, and rapids. If two observers note at the same time the temperature of the water above and below the fall, it will be found to be different. It would seem that the splitting of the water, so to say, causing a more prompt evaporation, cools it, so that below the fall the water is generally colder than above it. In these cases, the height of the fall should be stated, because if it be great, the warmer atmosphere below, may compensate in some measure for the refrigerating effect of the fall.

TO TAKE THE TEMPERATURE OF RAIN.

This is not easy to do exactly; but as the temperature of

rain has great influence on vegetation, it should always be ascertained, if possible. For this purpose we recommend the use of a bent thermometer so fitted into the rain guage described sect. *Instruments*, that its bulb which should be flattened, shall be immediately below the orifice of the funnel from which the water flows into the guage. The temperature must be observed at different periods of the shower. In taking the temperature of rain, the time of day and the date, and the temperature of the air before and after the rain should be noted, as also the temperature of the air during the shower, observed by a sheltered thermometer.

TO TAKE THE TEMPERATURE OF THE SOIL.

The temperature of the soil at what may be regarded as its surface is easily observed. Surround the bulb of your thermometer with some non-conducting substance; put it into a strong wooden box, but which may be readily opened, and bury it at depths of 3, 6, 9, 12, &c., feet in the soil. A rope should be fastened to the box, with its extremity above ground, to serve as a guide for digging the box up again. The instrument should be left in the ground twelve hours, and the time it is taken up should be indicated, and, with the temperature marked by the buried instrument, should be noted that of the air at the time of burying and of taking up the instrument out of the ground. This operation, simple as it is, cannot always be performed by the traveller for want of time or other reasons; but those who remain any time in the same place, should examine as far as they can, the temperature of different soils at different depths, in different seasons, and in different localities. The depth to which soil freezes is particularly interesting; but in order to ascertain this, the soil must be dug and examined, not only by placing a thermometer in the soil so dug, but by examining it with a magnifier in order to discern the interspersed spiculæ of ice. When the temperature of a soil likely to freeze is to be observed, bottles filled with spirit should be buried in boxes, stuffed with some bad conducting substance, and the necks of the bottles, being of a size to admit the thermometer, this latter should be immediately plunged into the liquor when the bottle is drawn up, and quickly read off.

The temperature of sand is taken by simply sticking the naked thermometer into it and observing its indication; but

we recommend wrapping a fold of paper over that part of the instrument which is plunged into sand or soil, to prevent the scratching of the glass.

TO TAKE THE TEMPERATURE OF THE GASES RISING FROM VOLCANOES.

The thermometer should, as in the case of mineral springs, be protected by a glass tube ; and when it is required to ascertain the temperature of the hot chasms or fissures of volcanoes or the temperature of thermal springs, the bulb of the instrument must be surrounded with bad conductors.

TO OBSERVE THE ATMOSPHERIC PRESSURE.

We have recommended to the traveller to take with him at least one, if not two, of Newman's mountain barometers. This instrument may be used not only for the measurement of heights, but for observing the atmospheric temperature at all times and in all places.

To say that observations of atmospheric pressure are the most important in the whole range of meteorology would be incorrect, in as much, as unaccompanied by observations of temperature, and humidity, &c., they would really be of little interest ; but, on the other hand, we may safely say, that no meteorological observations are satisfactory, unless accompanied by indications of the atmospheric pressure. The traveller, then, should read off the instrument at the hours indicated under the article *temperature*. No particular instructions are needed for this purpose, but we will copy, for the traveller's guidance, the following passage from the "Report of the Committee of Physics of the Royal Society," a report which every traveller should have in his baggage :—

"The barometer should be placed in an apartment subject to as little variation of temperature as possible, and in a good light ; great care should be taken to fix it in a perpendicular position by the plumb line. Its height must be carefully ascertained above some permanent and easily recoverable mark, either in the building in which it is situated, or in some more permanent building or rock, in its immediate vicinity ; and no pains should be spared to ascertain the relation which such mark may bear to the level of high and

of low water at spring tides, and ultimately to the mean level of the sea."

The corrections necessary for observing with Newman's portable barometer, have been pointed out in the description of the instrument; see *Instruments.*

TO DETERMINE THE TRANSPARENCY OF WATER.

Experiments on the transparency of water should always be made, if possible, when the sun is shining, and at or near mid-day, and in calm weather or when the surface is the least ruffled. In all cases, the time of the day, the state of the sky, and the surface of the water should be stated. The comparative transparency is determined by the depth at which objects are visible; but as light coloured and bright objects show better than others, they should be preferred: moreover, in order that the several experiments be comparable, it is desirable to use always the same or similar objects. The form of the object is far from being indifferent; of two bodies of the same nature, size, and colour, but flat, lying at the bottom of transparent water, the one may be distinctly seen, and the other not perceived, according as the position in which they lie is favourable or not to the light falling on them being reflected back to the eye. For this reason we recommend the use of the small copper ball described under *Instruments*, and attached, as there stated, to a lead and measured line. The instrument must be let down gently till it disappears, then brought up again till it comes just in sight, and the depth at which this takes place must be noted. An universal expression for indicating the transparency should be used, and we venture to recommend as the simplest, the number of feet. Thus, transparency 22·5 would indicate that the transparency of the water was such, that the ball was visible at the depth of between 22 and 23 feet; and here we will remark that as it will, in practice, be found almost impossible to determine the exact moment between the mere visibility and vanishing point, it is always best to bring up the ball till the bright speck is certainly seen. After all, though the observations on the transparency of different waters are very interesting, the difference of a few inches is no object, the more particularly as much will always depend on the vision of the observer.

The ball should be wiped quite dry after every operation, and put away at once in its case.

TO OBSERVE THE COLOUR OF WATER.

Mr. Arago recommends that the colour of sea water, as also that of lakes and rivers, be observed by means of a large hollow prism, whose refracting angle is 45°. To observe with this instrument, let the refracting angle dip into the water, the prism being held horizontally and with one face of the angle, that turned from the spectator, being vertical, in which case, the other face will of course be inclined 45° to the horizon. The instrument being thus disposed, the light which traverses horizontally, just below the surface of the water, will strike the vertical side of the prism, will penetrate it, and reach the face turned towards the observer, whence it will be reflected vertically, so that on looking down upon the inclined face, the colour of the water will be seen.

We give this method as being the only one with which we are acquainted that seems philosophical; but we cannot help observing, that even if this method were calculated satisfactorily to solve the intricate question of the colour of water, it could but seldom be employed, conveniently for the observer, and perhaps never in those cases where the singularity of tint renders its examination the more desirable.

Where no instrument is used, the traveller must be content to observe the tint of the water as it appears to him, taking notice of the nature and colour of the bottom, the height of the sun, the angle under which he views the water, the state of its surface, as smooth or agitated, the state of the sky, &c. Having done all this, two objects are still necessary to be attended to; the precise determination of the colour the water presents, and the cause of this colour, if it can be ascertained.

As for the former of these two objects, we know of no better way than by a comparison with a very complete chromatic scale of tints, which no traveller should be without, although, unfortunately, science has not yet discovered a means of making chromatic scales comparable at all times and in all places.

As for the cause of the tints which water presents, it is

difficult to determine satisfactorily, unless when the water contains foreign substances, which though often exceedingly small, may be detected by taking up a portion of the water and examining it with a good microscope.

TO ASCERTAIN THE QUALITY OF WATER.

It is very interesting to know the quality of sea water, taken up in different places, and at different depths, as also that of salt and bitter lakes, and of mineral springs. The traveller will seldom be enabled to make an exact analysis of water, which, to be done correctly, is a delicate and difficult operation, but he may, by the use of a few tests, ascertain generally the quality of water without much trouble; we shall therefore describe here how he should proceed, throwing into the form of an appendix, a more rigorous method, which may be employed by those who have time and opportunity.

The requisite tests are:

1. Litmus paper or tincture of litmus, for the detection of uncombined acids generally.
2. Muriate of Barytes, for discovering carbonic and sulphuric acid and ascertaining whether litmus paper or tincture that has been reddened, has been so by carbonic acid gas or sulphuretted hydrogen gas; the muriate forming a precipitate in the former case, and none in the latter.
3. Nitrate of silver, for detecting muriatic acid.
4. Oxalic acid, for discovering lime.
5. Ammonia, for detecting magnesia; and,
6. Tincture of galls, for iron.

The presence of alkaline neutral salts and their quantity, is discovered by evaporation, drying, and weighing.

Mineral waters are either carbonated, sulphureous, chalybeate, or saline; but all of them are either saline or may be reduced to such. From water of the first and second kinds, the carbonic acid gas, and the sulphuretted hydrogen gas, may be expelled by boiling; the iron of chalybeate waters may be detected by its particular test, and removed by appropriate methods; in all these cases the water remains with only its saline impregnation.

The salts usually contained in mineral waters are the carbonates, sulphates, and muriates of lime, magnesia, and soda,

and these are severally detected by the tests above mentioned.

First ascertain by litmus paper or the tincture of litmus, if there be any acid in the water, which will turn the paper or tincture red. If the paper be reddened, then boil a portion of the water and test again with the paper or tincture ; if the paper still reddens, the acid was a fixed acid, but if no change takes place in the colour of the paper or tincture, the acid which first coloured it has been driven off by boiling, and is thus discovered to be a free acid. The acid though free may be either the carbonic acid or sulphuretted hydrogen, which acts as an acid,—the latter is generally detected by its fetid smell ; but for greater certainty, drop into a portion of the unboiled mineral water a little barytic water, when, if no precipitate takes place, the reddening of the test paper or tincture, is owing to sulphuretted hydrogen ; whereas if it be due to carbonic acid gas, the water will instantly become turbid, and a precipitation will be formed, which is soluble with effervescence in dilute muriatic or nitric acid. The presence of a free acid, if there be any in the water, and its nature being thus detected, boil some of the water to drive off this acid, and divide it into portions, to which apply the several tests ; and thus a sufficiently general knowledge of the composition of the water will be obtained, to enable the traveller to set it down as belonging to the carbonated, sulphureous, chalybeate, or saline class.

When the traveller has no tests he should, if it will not too much burthen him, take bottles of the water to be subsequently analysed. In doing this, care must be taken that the bottles used be perfectly clean, and when filled they should be corked under water, and then well sealed. In taking water from springs, it should be done at the very spot where the water first comes out, as otherwise a portion of the uncombined gases it may contain, will be evaporated.

TO TAKE THE SPECIFIC GRAVITY OF WATER.

This may be done in various ways, and by different instruments ; but as a traveller cannot be expected to carry with him any but the simplest and most portable of these, and as he cannot devote to the exacter modes of operating the time which they require, it will be sufficient for him to take

the specific gravity of the water he may wish to examine by means of the hydrometer described, Sect. INSTRUMENTS.

If it be required to take the specific gravity of the water of a spring, of a well, or even that of the sea, or of a lake or of a river at its surface, all that is necessary is, to take up, in any convenient vessel, a quantity of the water sufficient for the immersion of the hydrometer. But if it be required to take the gravity of water drawn up from a depth, then recourse must be had to the instrument we have described for drawing up water from a depth.

Two precautions are necessary; first to filter the water, if it contain any insoluble impurities floating in it, and secondly to note the temperature of the water. This last is essential, for, before the specific gravity of the water can be exactly known, its temperature must be reduced to the temperature of maximum density. There are tables for this, but the reduction need not be made till the traveller return to his head quarters.

TO BRING UP WATER FROM CONSIDERABLE DEPTHS.

The mode of doing this is sufficiently explained by the description and use of the instrument recommended for the purpose and described Sect. INSTRUMENTS.

TO ESTIMATE THE EVAPORATION FROM STANDING OR RUNNING WATER.

We know of no method by which this can be done directly and exactly. It can only be approximately calculated from observations with Leslie's Atmometer, or with the hygrometer, see *Atmometer*, Sect. INSTRUMENTS.

TO OBSERVE THE QUANTITY OF RAIN, SNOW, OR HAIL.

For observations of the rain which falls see *Ombrometer*, Sect. INSTRUMENTS. As for the quantity of snow which falls we may remark, that if there falls but little, it is hardly worth observing, as the small quantity that could be collected would not give any satisfactory result. If, however, the snow melts as soon as it falls, it may be collected in the Ombrometer like rain. But when much snow falls, the

better way is perhaps to look out for a spot where it has neither been accumulated by drift nor carried away by wind, and there to take the depth at which it lies; after which take up a square foot of it as exactly as possible, thaw it and measure the cubical inches of water it furnishes. The duration of the fall should be noted, and the snow taken up as soon as the fall is over.

With regard to *hail* it may be collected in the rain guage, but as the hail stones are apt to rebound the estimate will probably be short of the real amount. The box of the guage without its funnel would answer better. But by whatever means the hail stones are collected on a given space, they must be thawed and the quantity of water resulting, measured. Observe also if there be any sediment in the water resulting from the thawed hail, and if so, in what quantity and of what kind; it may be common sand or fine volcanic dust, &c.

TO OBSERVE THE QUANTITY OF DEW WHICH FALLS.

The *Drosometer* to be employed for this purpose, and which we have described Sect. INSTRUMENTS, should be used as follows—

Blacken the inside of the tin or copper funnel over the flame of a candle or lamp, so as to cover it completely with a coating of soot. Then screw it into the graduated tube, and the tube into its stand. Set the instrument on the ground, out of the way of shade or current. In the morning observe the quantity of dew collected and note it down.

TO OBSERVE THE FORCE OF THE WIND.

For this purpose we have recommended the use of Lind's wind guage, which see, Sect. INSTRUMENTS.

To observe with this instrument it must either be held in the hand, or, still better, securely placed in some open situation, away from all eddies and reflected currents of wind. The date and hour of the observation must be recorded, the quarter whence the wind began to blow, and the direction it takes in veering. When the wind blows in gusts, the maximum effect of these should be noted.

TO OBSERVE SOLAR RADIATION.

For this purpose, the particular thermometer described in Section INSTRUMENTS should be employed. It is recommended to set it about an inch above the bare soil and screen it from currents of air. It must of course be so placed as to receive the full influence of the sun's direct rays at those hours of the day when they are hottest, and the maximum of each day should be regularly entered. The observations can be regular only when the traveller is stationary, but it is interesting to note the intensity of solar radiation, when it can be done, during even a temporary halt, noting the date and hour when the observation was taken, and whether the heat was still increasing, or was stationary or diminishing, at the time of taking up the instrument.

TO OBSERVE TERRESTRIAL RADIATION.

The observation of terrestrial radiation may be more regularly effected by the traveller than that of solar radiation; for he generally rests at night, and has therefore many opportunities of setting out the parabolic metallic mirror we have described, and noting the indication of its thermometer, in the morning before he resumes his journey. The instrument must be screened from currents of air, but away from the vicinity of any high buildings, trees, or other objects which conceal a considerable portion of the heavens. It is better to set it on the top of a house than on the ground near it; but in all cases, its height above the ground and the nature of the soil or other object over which it is immediately placed, should be noted, and the direction in which unavoidable obstacles to free exposure exist, with the proportionate part of the heavens they hide from the instrument.

TO OBSERVE THE ELECTRICAL STATE OF THE ATMOSPHERE.

It were very desirable that the electrical state of the atmosphere should be observed at the regular hours that other meteorological observations are made; but, although

make-shift conductors may be occasionally set up, yet the traveller cannot always command even such: besides which, he cannot always observe at stated times, nor after all, is so capricious an element as atmospheric electricity sufficiently understood for casual observations to be of much use. If, however, a traveller choose to take with him one of the electrometers we have mentioned, Sect. INSTRUMENTS, and remains for a sufficient length of time at any place, he may set up a conductor and observe the indications of the electrometer; and this he should do, not only at the stated hours, but also before, during, and after storms, rain, snow, &c. When the electroscope is charged, unless Bohnenberger's is used, the nature of the electricity may be tested in the usual way, by excited glass or sealing wax.

TO OBSERVE TERRESTRIAL MAGNETISM.

The magnetism of thé earth is now exciting that general attention among philosophers to which it is so justly entitled. It was, therefore, our intention to give the traveller some short instructions relative to such observations as he might have opportunities to make upon it with the more ordinary and portable instruments. But, reflecting on the great nicety required in making magnetic observations, in order that they may be really useful, and that, as we have before observed, a kind of apprenticeship is absolutely necessary to enable any one to observe properly, we have thought that a few words on the subject would be worse than nothing, while to enter into details would lead us too far. We have therefore merely named the instruments which a traveller may take with him without inconvenience, and with which, when he is properly instructed in the mode of observing, he may obtain much useful and interesting data. He is recommended to read with attention the articles on magnetism in the fifth and eighth parts of Taylor's Scientific Memoirs, and the remarks on instruments and methods, in the eighth volume of the Reports of the British Association.

TO COLLECT THE GASES FROM VOLCANOES, SPRINGS, &c.

This is an operation which the casual traveller can hardly have time or opportunity to perform; as it is, however, de-

sirable to ascertain precisely the nature of the gases given out by volcanoes, springs, &c., we will point out a mode by which this may be effected.

Fill a bottle with water and invert it into a basin having some water in it and a slip of wood laid across with a notch cut out to receive the neck of the bottle. Insert one end of a double bent tube* having this form into the nozzle of a funnel by means of a cork or otherwise, so that gas may not escape at the juncture. Slip the other end of the bent tube into the neck of the bottle. Having thus arranged your pneumatic trough, fasten all firmly, so that nothing may move, and set the apparatus with the inverted funnel over the evolving gas. If there be any inconvenience or danger attending a too near approach, fix the whole to a ring at the end of a pole, like the ring and handle of a landing net, and hold the apparatus over the gas till the bottle be full, which it will be when all the water is expelled. Then remove the tube, and cork your bottle under water. The water used must not be thrown away, but bottled for examination, as it may have imbibed some principles from the gas which passed through it.

A portable apparatus for collecting the gas might be easily imagined, and would be found very useful on many occasions.

TO OBSERVE THE DIRECTION OF THE UNDULATORY MOTION OF EARTHQUAKES.

When a traveller visits regions where earthquakes are frequent, he would do well to provide himself with such an instrument as is described in the Section INSTRUMENTS; and as no warning is given of an approaching earthquake, he should always set his instrument wherever he may halt for any time. The description of the instrument sufficiently indicates the mode of observing with it.

TO MEASURE THE HEIGHTS OF MOUNTAINS.

Trigonometrically.—The only correct method of obtaining the heights of mountains is by trigonometrical measure-

* A flexible tube might, on many occasions, supply the place of a glass tube with advantage; and such a one might be made to screw on to the end of a funnel.

ment ; but for this, the requisite instruments are necessary as well as time, besides which, the locality is not always favourable for the measurement of the required base, which should always bear a certain relation to the height and distance of the object ; moreover those alone who are proficients in trigonometry can employ this method, and for such it were superfluous to enter into the *modus operandi*, while for the uninitiated it would be necessary to go into details which would occupy too much space here and may be found fully treated of in works on Geodesy.

Barometrically.—The next most accurate method of measuring the heights of mountains is by means of the barometer, which, indicating the diminution of atmospheric pressure as the column of air becomes shorter in ascending from the level of the sea, is most usefully applied to the measurement of heights. For this purpose peculiar forms and adjustments of the instrument have been made to render it portable. Of the portable or mountain barometers there are two kinds in general use, the syphon barometer of M. Gay Lussac, and Newman's mountain barometer, of which the description and use will be found in Sect. INSTRUMENTS.

In order to obtain heights as exactly as possible with the barometer, two instruments are indispensable : these should be compared before observing with them, and any difference in their indications noted. One observer at the lower, and one at the higher station, should make ten or a dozen simultaneous observations at intervals of a quarter of an hour, beginning at an appointed time, having previously compared their watches, and when the operations are concluded, the instruments should be again compared.

Supposing the traveller to be fully acquainted with the formula for calculating the heights, from his barometrical observations, and which if he be ignorant of, it were useless for us to insert, unaccompanied by the requisite tables, without which he could not work out his result ; we will merely remark, that barometric admeasurements are by no means exact, there being many sources of error derived from various causes, 1st, from imperfections in the instruments themselves, including their thermometers. 2nd, from capillarity ; this however in the case of Newman's barometer is corrected. 3rd, from the comparison of the two instruments and the position of the eye. The errors from these causes may amount to the tenth of a millimetre ; which in the measured height corresponds to from 3 to 7

feet according to the elevation above the sea. 4th, A difference of half a degree in the estimated and real temperature of the whole barometric column, which on the ground would correspond to about 5 feet, at whatever height the instrument may be ; and 5th, the difference of a degree in the real temperature of either station, at either one of which it would correspond to a 0·002 of the estimated height. It is not however likely that all these errors will point the same way, so that they partly correct each other ; and the result obtained, though not rigorously exact, will, if the observations are made with care, and a mean taken between several, come within 10 feet in the greatest heights.

It may also be well to remark that, it is by no means a matter of indifference at what hour of the day the observations are made ; those of the morning give a diminished result, those of the afternoon a somewhat higher, and those of mid-day give the greatest height. Raymond found, from many observations, an error of 60 métres in a height of 2613 métres. The general temperature of the day, as warm or cold, produces also a notable difference, though not so sensible as that observed at different hours, the colder weather giving the less height. The season greatly influences the result ; thus, in the estimated height of San Bernard above Geneva, the seasonal differences alone have been found to range from 24 métres below, to 28 métres above the real height of 2114 métres. Besides these sources of error, there are those which arise from disturbing atmospheric causes, as wind, rain, snow, or hail, the approach of a storm, &c., and the great horizontal distance of the two stations ; notwithstanding all which, the barometer is an invaluable instrument for the estimation of heights in the absence of trigonometrical measurements.

If so many precautions are necessary, when there is time and opportunity, it is evident they cannot be taken by the traveller, who has frequently neither ; he generally has but one barometer, or if he have a second, often finds it inconvenient or unsafe to separate himself from his companion. Moreover he has seldom the choice of hours of observation and still less frequently of days, without a great loss of valuable time. He must therefore observe as best he can, keeping his instrument, when observing, in the shade, that of his body will do if no other object be at hand. Care should also be taken of putting either the barometer or the detached thermometer within the influence of reverberating

bodies; thus a rock long heated by the sun's rays will emit heat to the immediately circumambient air and raise it above the real temperature of the station, which will affect the instruments though they be shaded from either direct radiation of the sun or from its reflected rays.

We will conclude these remarks by recommending the most accurate observation of the indications of the instruments, and the noting down of the date and hour, the weather, the season, the nature of the soil at the spot, and the height of the instruments above it. The traveller may leave till his return to head quarters, the calculation of the heights from his registered barometrical observations.

Thermometrically.—The next method of measuring the heights of places, we shall mention, is by means of the boiling point of water. It has been found that water boils at diminished temperatures according as the atmospheric pressure is less, and thus the boiling point of water, at different heights, is made to measure these heights. The thermometer used for this particular purpose has been described Section INSTRUMENTS. Its great portability is its chief recommendation, for it is subject to many errors; nevertheless, when we consider the little time which travellers often have for making anything like strictly satisfactory barometrical observations, and that the errors in their results may sometimes be considerable, particularly when the temperature and pressure at the level of the sea are *assumed*, we can the more readily reconcile ourselves to the use of the thermometer, especially as Col. Sykes assures us, (and he has had long practice with this instrument,) that sufficient accuracy may be obtained with it for all the practical purposes of physical geography.

The mode of operating is simple. Before starting, the boiling points of the thermometers must be ascertained at the level of the sea, in order afterwards to add or deduct from the temperatures observed, the quantities above or below 212 of Fahrenheit (or 100 of the Centrigrade), marked by the instruments as the boiling points of water at the sea. Where an observation is to be made, it should be conducted in the following manner practised by Col. Sykes. "From four to five inches of pure water were put into the tin pot. The thermometer was fitted into the aperture in the lid of the sliding tube by means of a collar of cork; the tin tube was then pushed up or down to admit of the bulb of the thermometer being about 2 inches above the bottom

of the pot. Violent ebullition was continued for ten minutes or a quarter of an hour, and the height of the mercury was repeatedly ascertained during that time, and the temperature of the air was noticed. Similar operations were repeated with a second thermometer, for it is never safe to rely upon one instrument."

Having obtained the boiling points, it remains to determine the value of the indications of diminished pressure, when the observations are taken above the level of the sea. For this purpose tables are used which, as they are short, we shall here insert ; observing, that as the degrees in the tables are those of Fahrenheit, it will be necessary, if centigrade thermometers are used, to turn these indications into the corresponding ones of Fahrenheit for which the formula is

$$F = \frac{9\,c}{5} + 32$$

whenever the degrees are above the freezing point of water.*

* If Fahrenheit's thermometers are used, and it be desired to convert its indications into those of the Centigrade, the formula is

$$C = \frac{(F-32)\times 5}{9}$$

Table I.

To find the Barometric Pressure and Elevation corresponding to any observed Temperature of Boiling Water between 214° and 180°.

Boiling Point of Water.	Barometer Modified from Tredgold's Formula.	Logarithmic Differences or Fathoms.	Total Altitude from 30·00 inch. or the Level of the Sea.	Value of each Degree in Feet of Altitude.	Proportional part for One-tenth of a Degree.
°			Feet.	Feet.	Feet.
214	31·19	00·84·3	—1013	—505	..
213	30·59	84·5	507	—507	..
212	30·00	84·9	0	+509	..
211	29·42	85·2	+509	511	51
210	28·85	85·5	1021	513	..
209	28·29	85·8	1534	515	..
208	27·73	86·2	2049	517	..
207	27·18	86·6	2566	519	52
206	26·64	87·1	3085	522	..
205	26·11	87·5	3607	524	..
204	25·59	87·8	4131	526	..
203	25·08	88·1	4657	528	..
202	24·58	88·5	5185	531	53
201	24·08	88·9	5716	533	..
200	23·59	89·3	6250	536	..
199	23·11	89·7	6786	538	..
198	22·64	90·1	7324	541	54
197	22·17	90·5	7864	543	..
196	21·71	91·0	8407	546	..
195	21·26	91·4	8953	548	..
194	20·82	91·8	9502	551	55
193	20·39	92·2	10053	553	..
192	19·96	92·6	10606	556	..
191	19·54	93·0	11161	558	..
190	19·13	93·4	11719	560	56
189	18·72	93·8	12280	563	..
188	18·32	94·2	12843	565	..
187	17·93	94·8	13408	569	57
186	17·54	95·3	13977	572	..
185	17·16	95·9	14548	575	58
184	16·79	96·4	15124	578	..
183	16·42	96·9	15702	581	..
182	16·06	97·4	16284	584	..
181	15·70	97·9	16868	587	..
180	15·35		17445		59

The fourth Column gives the Height in Feet.

Table II.

Table of Multipliers to correct the Approximate Height for the Temperature of the Air.

Temperature of the Air.	Multiplier.	Temperature of the Air.	Multiplier.	Temperature of the Air.	Multiplier.
32°	1·000	52°	1·042	72°	1·083
33	1·002	53	1·044	73	1·085
34	1·004	54	1·046	74	1·087
35	1·006	55	1·048	75	1·089
36	1·008	56	1·050	76	1·091
37	1·010	57	1·052	77	1·094
38	1·012	58	1·054	78	1·096
39	1·015	59	1·056	79	1·098
40	1·017	60	1·058	80	1·100
41	1·019	61	1·060	81	1·102
42	1·021	62	1·062	82	1·104
43	1·023	63	1·064	83	1·106
44	1·025	64	1·066	84	1·108
45	1·027	65	1·069	85	1·110
46	1·029	66	1·071	86	1·112
47	1·031	67	1·073	87	1·114
48	1·033	68	1·075	88	1·116
49	1·035	69	1·077	89	1·118
50	1·037	70	1·079	90	1·121
51	1·039	71	1·081	91	1·123

Enter with the mean temperature of the stratum of air traversed, and multiply the approximate height by the number opposite, for the true Altitude.

When the thermometer has been boiled at the foot and at the summit of a mountain, nothing more is necessary than to deduct the number in the column of feet opposite the boiling point below from the same of the boiling point above: this gives an approximate height, to be multiplied by the number opposite the *mean* temperature of the air in Table 2, for the correct altitude.

Boiling point at summit of Hill Fort of Púrundhur, near Púna . .	204°·2 =	Feet. 4027
Boiling point at Hay Cottage, Púna	208·7 =	1690
	Approximate height	2337
Temperature of the air above 75°		
Ditto ditto below 83		
	Mean 79 = Multiplier	1·098
	Correct altitude	2·566 feet.

When the boiling point at the upper station alone is observed, and for the lower the level of the sea, or the register of a distinct barometer is taken, then the barometric reading had better be converted into feet, by the usual method of subtracting its logarithm from 1·47712 (log. of 30 inches) and multiplying by ·0006, as the differences in the column of "*barometer*" vary more rapidly than those in the "*feet*" column.

		Feet.
Example.—Boiling point at upper station	185° =	14548
Barometer at Calcutta (at 32°) 29 in. 75°		
Logar. diff. =1·47712—1·47349=00363+0006=		218
Approximate height . .		14330
Temperature, upper station, 76° / Ditto lower, 84°	80=multiplier	1·100
Correct altitude		15763

Assuming 30·00 inches as the average height of the barometer at the level of the sea (which is, however, too much) the altitude of the upper station is at once obtained by inspection of Table I, correcting for temperature of the stratum of air traversed by Table II.

Newman, Optician, 122, Regent Street, has been in the habit of making these instruments; he recommends the use of copper brazed, instead of tin, as more durable; and a free escape for the steam, or the results will be incorrect from the boiling taking place under pressure. The same optician constructs the thermometers and other instruments we have recommended, Sect. INSTRUMENTS.

Of course, a bottle of pure water, and fuel and matches must be taken to the top of the mountain, as water may not be there found, or any fuel but such as is green and requir-

ing time to kindle, the more so as at great heights, the air being more rare, there is a less abundant supply of oxygen. The surest and readiest way is, to be provided with a spirit lamp having three wicks, so that the flames may extend over the whole bottom of the pot and set the water boiling without delay. But as a quantity of alcohol cannot always be carried by the traveller, the lamp should be used only on emergencies. The water employed should be very pure; if such cannot be had it must be boiled and filtered before using.

The height to be found by the indications of the thermometer need not be calculated at the time, but the data must be noted on the spot. Col. Sykes very properly recommends, as well as Mr. Prinsep, that every traveller, having a barometer, make a record of its indication at the same time that he observes the boiling points of his thermometer.

METHOD OF TAKING THE DIP AND STRIKE OF STRATA.

As in almost every case, the surface and edges of strata are very rough and uneven, when viewed in small portions, it is evident that their dip and strike cannot be obtained by a consideration of such portions; moreover, the sections exhibited by nature seldom present either the true line of strike or of dip. The dip is the angle which the plane of the strata makes with the horizon; hence the angle formed by the plane and the horizon must be taken by a line at right angles with the intersection of the plane and the horizon, or at right angles to what is termed the strike. If the true strike, which is the intersection of the plane of the strata with the horizon, or a line parallel to this, can be had, then a line perpendicular to this, and in the plane of the strata, will be the true line of dip, whose angle with the horizon is to be taken as indicating the inclination of the strata. Or, if the true line of dip be obtained, the perpendicular to this will be the line of strike. The difficulty is the obtaining of either of these lines, and without the one, the other cannot be found. The line of strike is, perhaps, the most easily found, though the edge of the strata appearing above ground for miles will not give the strike, if this edge be at different levels at its extremities, as is most generally the case. If any two points of this out-cropping are at, or nearly at, the same level, then a line, passing through these two points, will

be the true strike, and the dip must be taken by a line perpendicular to this and in the plane of the strata.

Various instruments have been invented for taking the dip and the strike of strata, but we hardly know which to recommend. Sir H. de la Beche has given the figure of one in his admirable book on "How to Observe, Geology,"* which is very simple, and we have no doubt answers perfectly well; but we fear its form is inconvenient for stowing away in a traveller's limited baggage. Nor will this or any other instrument afford the required information unless the true line of dip or strike can be obtained. Sir H. de la Beche's mode of noting on a map the dip of a rock, and consequently its strike or direction when found, should invariably be followed, as it is particularly well devised; it is as follows.

An arrow thus ↓, pointing to the direction of the dip on the map, denotes that direction, and the number of degrees may be written by the side of it. A crooked arrow shows, that while the strata undulate in the small scale, they dip, as a mass, in the direction pointed out by the arrow. Perpendicular strata are represented by , the longest line showing the strike of the beds. Contorted strata, whose strike is ascertained, but which show no given dip, is marked thus , the long line being, of course, traced in the direction of the strike. Strata so contorted that neither dip nor strike can be represented is indicated thus, . An anticlinal line is shown by this mark , the long line pointing out the direction of the strike, and the arrows the dipping of the strata on either side. Horizontal strata are repre-

* We cannot too strongly recommend Sir H. de la Beche's "How to Observe," to every traveller.

sented by Sir H. de la Beche by a cross thus +, we would have preferred two parallel lines thus =, but this is indifferent; as the signs are arbitrary, each may devise such as he may prefer for his own use, though we by no means recommend the practice, uniformity being most desirable in such matters.

TO TAKE THE LENGTH, BREADTH, CIRCUMFERENCE AND SURFACE OF LAKES.

If square, the side will of course be both length and breadth; if oblong, the longest side will be the length, and the shortest the breadth; if round, take the diameter; if oval, take the two diameters; if the shape be triangular, take the length of one of the sides if they are nearly similar, and of the base of the triangle and of one of the other sides, if the triangle be a short or long isosceles; when the lake is of a long, narrow, and winding form, it may be well to take two lengths; that of the lake itself must be measured along a line traced in the general direction of the lake, and as equidistant as possible from either side, and the other distance must be from the extreme points in a straight line, whether it pass over the land or not. For this kind of lake, and generally for such as are irregularly wide, the greatest, the least, and the general medium breadth should be taken. All breadths must invariably be taken perpendicularly to the line of length. In the case of extraordinary forms and irregularity, various dimensions should be taken, and the directions in which these are taken must be well defined.

Lengths and breadths actually taken on the water, and not estimated between points obtained by intersection or otherwise, may be measured by ascertaining the rate of rowing, and finding how long it takes to row from end to end of the lake, and across it.

The length and breadth once obtained, if the form be at all regular, the perimeter is easily found by calculation; in other cases actual admeasurement must be had recourse to. Whenever a sufficient number of points at the circumference can be obtained by intersection, these may be united by

lines, which being measured and a proper allowance over and above being made, the circumference will be ascertained with sufficient accuracy for the ordinary purposes of geography; but if this plan cannot be followed, then the circumference may be found by the time required to walk or ride round the lake, making due allowance whenever the various sinuosities are not closely followed.

The surface of a lake is easily found when its dimensions and form are known. Thus, if it be circular, or nearly so, multiply the circumference by a quarter of the diameter; if it be oval, multiply the transverse and conjugate diameters together, and the product by ·7854; for a square, multiply the side by itself; for oblong, the long side by the short; for triangular, the perpendicular by half the base; and for all irregular figures divide them into triangles, and taking the surface of each of them, add them together.

It is interesting to know the surface of lakes in order to ascertain the probable evaporation from them, which has great influence on the climate of the surrounding country.

TO COPY INSCRIPTIONS.

At page 239 we referred the reader to the present article: we had hoped to be enabled to point out to him some expeditious, and at the same time correct mode of copying inscriptions; but we are sorry to say, all our inquiries on the subject have been unsuccessful. This, is, however, not so much to be regretted, perhaps, as the probable perfection to which the art of photogenic copying will shortly attain, may furnish a means preferable to every other. In the mean time we may inform the traveller of a mode we have seen executed with the most perfect success for copying large intaglios in marble and metal, such as some of those large monumental slabs of brass which are found in our cathedrals. It consists in merely stretching one or more large sheets of thin paper over the object, holding it there, and rubbing it over with the black waxy composition technically called *heel-ball.* This blackens the whole of the paper save those parts that are over the hollows, and which remain white. This means is most expeditious and effective; the copy is a perfect fac simile; the black does not easily rub off, and the paper, being thin, a large quantity takes up very little room.

TO MAP A COUNTRY.

In traversing a country but little known, it is not sufficient that the traveller observe men, manners, and things, and describe the same, he must to his faithful description add as faithful a graphic delineation of the parts he visits as his time and opportunities will allow him to make. It cannot of course be expected that in his rapid course he should make a regular survey, but he may, and that by the aid of a very few portable instruments, lay down the principal features of a country on his line of route with sufficient accuracy to be of great service.

We will in the first place suppose that he has no map of the country. The principal objects whose position should be set down as accurately as possible are, the rivers and streams, their confluence and sources, and their direction; the chains or groups of mountains or isolated hills, the lakes, forests, and marshes, the roads and passes; the towns and villages, inhabited or in ruins, &c., nor should the traveller be satisfied with merely setting down these objects: he should also note as much concerning them as he conveniently can, as the breadth of the streams, the heights of the mountains, the extent of the lakes, the marshes and forests; the nature of the roads, passes and defiles; the number of houses in the towns and villages, and the precise native name or names of each particular object. The traveller should always, if possible, begin his mapping operations at some well known and defined spot; that is, at some place whose position has been astronomically or otherwise satisfactorily laid down.

Before starting from such place he may seek out a direction as level as possible on which to measure a base line, from the two extremities of which he may see the greatest possible number of remarkable objects; and assisted by a native, (if the confidence of the people admit of this,) to name to him the principal object he sees, take the angles they severally make with his base, with an angle instrument, as a circle, a sextant, &c., or their bearings by means of a compass. Having roughly sketched their position, marked their bearing, and drawn a meridian line on his paper, he should return to the known point, starting from whence he will observe the hour, and the direction he takes. As he proceeds he will keep his eye upon some distant object as a

check upon his change of direction: and on his route he must note every object he meets. If it be a stream that crosses the road, let him mark it and its distance from his starting point as measured by time, noting its breadth, the direction of the current and how the stream is crossed, as by a ford, a bridge, &c.* Having noted the stream, he proceeds, taking care also to mark the spots where the road on his route decidedly changes its direction. When he has gone some distance, more or less in proportion to the distance of the principal objects whose bearing he took at starting, let him take fresh bearings and distances of the same objects he took at starting and set them down, taking at the same time the bearings of such fresh objects as are important of themselves or may serve him as marks for rectifying his position. Let him also as he proceeds note down the objects on his right and left, with their distances as nearly as he can judge of them.

And here we must caution the traveller against setting down as positive anything merely conjectural; he may set down his conjectures if he please, but taking special care to mark them in such a way as to distinguish them from what is absolutely determined. The joining of detached portions of streams, which appear from their position and course to be continuations of the same is much to be deprecated, and when this is done, it very frequently happens that succeeding travellers find, either that what was presumed to be parts of the same stream, are in reality different and distinct streams, or that even if they be the same, their course is quite different from that which was presumed. We therefore strongly recommend to the traveller to lay down only as much of the course of a stream as he is actually assured of, and the same recommendation applies to every other object. There are few perhaps regarding which he is more likely to err than mountains. A group of mountains seen in the distance has often the appearance of a continuous chain, and the escarpments of a plateau or table-land, is still more easily taken for a chain of mountains. The traveller should therefore be cautious how he sets down distant mountains in his map as chains or ridges. If he should be careful how he sets

* For any detailed observations he may think proper to make on the stream beyond what is absolutely required for his map, we refer to the article *Rivers* in the former part of the present work; and in like manner of all other objects; so that we shall here mention those things only which refer to mapping.

down his own conjectures, still more guarded should he be in placing any thing upon his map from mere report. Indeed we would remind him that he is doing a much more essential service to geography by presenting a very bare map, but one which may be relied upon, as strictly correct in all that it contains, than by presenting a plan filled with details, where the merely guessed at is blended with the exact so as not to be distinguished, and wherein the discovered inaccuracies of the presumptions throw discredit upon the whole: but to return from this digression.

We have said that the traveller should choose some distant object in the line of his route and keep it in view as a check upon his direction; he must also observe the objects he has passed for the same purpose; and, in extensive plains when such objects are rare, he may in a very few moments set up a pile of stones to mark where he was.

The Latitude should be found by celestial observation at least once in twenty-four hours; if the traveller be at liberty to stop in the day for the meridian altitude of the sun, and that altitude be within range of his instrument it should not be neglected; but the true observation to trust to is the latitude by night from stars *north* and *south*, which, when travelling in a fine climate, can nearly always be obtained; the traveller then avoids the great heat of the sun, the delay caused by halting and unpacking his instruments by day; and the difficulty of measuring the altitude in low latitudes when the double angle is larger than a sextant can measure; certainly this latter is obviated by having a fixed instrument; but unless the traveller be a well practised observer, let him beware of Kater's azimuth and altitude instrument, or any instrument requiring adjustment, which is only fit for practised hands; in our humble opinion a sextant of five or eight inches radius or circle and artificial horizon of mercury, are the only safe instruments; but these of course are useless for the meridional altitudes of the sun in low latitudes.

When we enjoin caution in the use of all instruments requiring levelling we speak only to travellers unaccustomed to their manipulation, and although it be very desirable to have the most perfect instruments, still less depends upon them than upon the skill of the observer.

By these means a careful and industrious traveller can hardly fail of obtaining abundant materials for the correct laying down of his route, and should he traverse the country in different directions he will thus have a number of lines

crossing each other, forming a route map from which, for want of a regular survey, a very fair idea of the country may be gleaned, particularly when such map is accompanied by a detailed description.

Another essential object to which we would call the traveller's attention, is never to go to sleep until he has mapped his day's route and written up his journal from the notes of the day.

With regard to the bearings he may either lay them down on his map as indicated by the compass, that is, the magnetic bearing, or he may at once make the correction for variation and lay down the true bearings. But whichever mode he adopts he should mark whether it be *magnetic* or *true* north, on the face of every sheet of his map. In the former case, he must remember that his parallels of latitude will not run horizontally across his paper from right to left, unless he be travelling in the line of no variation. The safer method is to lay down his magnetic courses throughout his journey, on rough sheets of paper, and correct for variation and latitude on a fair sheet at the first protracted halting-place.

With regard to determining the Longitude of a place it may be remarked that this requires more knowledge than is requisite to find its Latitude, and travellers, in general, unfortunately, are not fitted by previous education for observations of this nature. When, however, the contrary is the case, and the traveller is provided with the requisite instruments, no pains should be spared, nor any time be considered misspent, in endeavouring to fix accurately the chief points in a country by independent observations for longitude, such as eclipses, particularly those of Jupiter's satellites, when both immersion and emersion can be observed, occultation of stars by the moon, by an altitude of the moon when in the prime vertical, or by lunar distances. These Methods rank in value pretty nearly in the order in which they are here placed. If corresponding observations at an observatory can be obtained, the two former methods may give the longitude within two or three miles. The two latter methods cannot be depended upon within from ten to fifteen miles, and even for this degree of accuracy an experienced observer, leisure, and good instruments are required.

The above methods, it will be remembered, will enable the observer to fix the longitude of a place *absolutely*, that

is to say, independently of the transport of time by a watch or chronometer. But for measuring short distances in longitude, it is probable that a good pocket chronometer will be the most serviceable. With common care we are of opinion that a watch may be carried by a traveller even on horseback, and keep a fair rate of going, but then he must not forget that he has a watch in his pocket that requires care, and must not dart off at full speed to hunt a wild boar here or an ostrich there; he must bear in mind that he has a higher object in view, and, that at the end of his journey, when he is enabled to lay down a correct map of his route, he will be amply repaid for the little self-denial he bore, in keeping steadily on at the jog trot pace of the baggage horses.

With care then, we repeat, a chronometer will measure short meridian distances and connect one place with another, so that all may be *relatively* right, in the map of a country, though *absolutely* wrong; and when at any subsequent opportunity, the longitude of any one point may be correctly determined, all will move together into its right position.

It is unnecessary here to enter into the details of the management of a chronometer, as the traveller must render himself familiar with it, before he begins his work. The great point is to find its *error* at any place, the longitude of which is known, and its *rate* whenever an opportunity is afforded, by stopping two or three days in any place of which it is necessary to know the longitude, and to make allowance for any alteration in rate over the whole route travelled since its rate was last determined.

The last and simplest mode of finding the longitude is by keeping an exact itinerary of the courses by compass and the distance travelled, measured by time; these corrected for variation, and checked by an observation for latitude, (except when travelling nearly east and west) will give a fair approximation to the longitude; and, whatever confidence the traveller may feel in his chronometer or his observations by eclipse, &c., this mode should never be neglected, as it will serve as a useful check to astronomical observations. Let the traveller then pay the greatest attention to this method; let him observe every change of course, and enter it down immediately in his filed book with the time. He should always have a compass in one waistcoat pocket, a watch in the other (both suspended round his neck), and a

prismatic compass for taking distant bearings of objects in the line of route, every time he stops, ready at hand ; and he will thus be enabled to lay down his track and determine his longitude quite near enough for all common purposes, and a steady traveller who attends carefully to this method may rest assured that he will do more for the cause of geography than nine-tenths of those who bring home what they call their "lunar observations."

B B

APPENDIX I.

ANALYSIS OF MINERAL WATER.

In the section OPERATIONS of the last division, we said a word on the mode of proceeding in order to acquire a general knowledge of the nature of mineral waters, we now propose giving some more precise instructions* for the benefit of those who, having time and the necessary materials, are desirous of determining more precisely the composition of the mineral waters they may happen to meet with.

Commence by ascertaining, as already directed, the general composition of the water, then proceed as follows.

1. Evaporate as much of the water to be examined as possible without having any precipitate or crystallization. This concentration drives off all the free carbonic acid, and renders the action of the re-agents to be employed more certain and more complete.

2. Add to the water thus concentrated a saturated solution of muriate of barytes as long as any precipitation is produced, taking care to avoid adding an excess. By a previous experiment let it be ascertained, whether this precipitate effervesces or not with diluted muriatic acid, and whether it is entirely dissolved. If it is, the precipitate is of course carbonate of barytes, the weight of which, when it is dried,

* Extracted from Accum's Treatise on Analysis and Chemical Tests.

gives the quantity of carbonic acid; 100 grains containing 22 of acid. If it do not effervesce, it is sulphate of barytes, the weight of which, in like manner, gives the quantity of sulphuric acid; 100 grains, dried at a low red heat, containing 34 of acid. If it effervesce and is partially dissolved, it consists of both carbonate and sulphate. To ascertain the proportions of these, let the precipitate be dried at a heat a little inferior to redness, and weighed; then submit it to the action of dilute muriatic acid; after this, wash it with water, and dry it by a similar heat, its weight will give the quantity of sulphate, and the loss of weight, that of carbonate of barytes.

By this operation the carbonic and sulphuric acids are entirely removed, and the whole salts in the water are converted into muriates. It remains, therefore, first to discover and estimate the quantities of the bases present, and then, to complete the analysis, to find the quantity of muriatic acid originally contained.

Add to the clear liquor (reduced by evaporation, and taking care to avoid any separation of any of its ingredients) a saturated solution of oxalate of ammonia as long as any turbid appearance is produced. The lime will be thrown down in the state of oxalate. Wash and dry the precipitate, then calcine it with a low red heat, by which it is converted into carbonate of lime, 100 grains of which are equivalent to 56 of lime. But as a portion of carbonic acid may be expelled if the heat is raised too high, or a little water retained if it is not high enough, it is proper to convert it into sulphate, by adding sulphuric acid to a slight excess, and then exposing to a full red heat. The dry sulphate of lime will remain, 100 grains of which contain 41·5 of lime.

Add to the liquor poured off after the precipitation of the oxalate of lime, heated to 100°, and, if necessary, reduced by evaporation, a solution of carbonate of ammonia; immediately drop in a strong solution of phosphoric acid, or phosphate of ammonia, continuing the addition with fresh portions, if necessary, of carbonate of ammonia, so as to preserve an excess of ammonia in the liquor as long as any precipitation is produced. Let the precipitate be washed; when dried by a heat not exceeding 100°, it is the phosphate of ammonia and magnesia, containing ·019 of this earth; but it is better for the sake of accuracy, to convert it into phosphate of magnesia by calcination for an hour at a red heat: 100 grains then contain 40 of magnesia.

Evaporate the liquor remaining to dryness, and expose the dry mass to heat as long as any vapours exhale, raising it towards the end to redness. The residual matter is muriate of soda, 100 grains of which are equivalent to 53·3 of soda, and 46·7 of muriatic acid.

Of the elements obtained by the analysis, form binary combinations according to the known proportions in which they unite; the excess or deficiency of muriatic acid will then appear, and the amount of the excess being subtracted from the quantity of muriatic acid contained in the muriate of soda obtained, or the amount of the deficit being added to that quantity, the real quantity of muriatic acid will be obtained.

Whenever from proceeding as above any error may be supposed to exist, or independent of this, to ensure perfect accuracy, it may be proper to estimate directly the quantity of muriatic acid in a given portion of the water, by abstracting any sulphuric or carbonic acid by barytes, and then precipitating the muriatic acid by nitrate of silver, or nitrate of lead. The real quantity will thus be determined with perfect precision, and the result will form a check on the other steps of the analysis, as it will lead to the detection of any error in the estimate of the other ingredients; for when the quantity is thus found, the quantity of these must bear that proportion to it which will correspond with the state of neutralization.

Thus by these methods the different acids and the different bases are discovered, and their quantities determined. To complete the analysis, it remains to infer the state of combination in which they exist. It will probably be admitted that this must be done on a different principle from that on which the composition of mineral waters has hitherto been inferred. The compounds which may be obtained by direct analysis cannot be considered as being necessarily the real ingredients; and to state them as such, would often convey a wrong idea of the real composition. There are two views according to which the state of combination in a saline solution may be inferred, and in conformity to which, therefore, the composition of a mineral water may be assigned. It may be supposed that the acids and bases are in simultaneous combinations; or if they be in binary combinations, the most probable conclusion with regard to this is, that the combinations are those which form the most soluble compounds; their separation in less soluble compounds, on evaporation,

arising from the influence of the force of cohesion. In either of these cases the propriety of first stating, as the results of analysis, the quantities of acids and bases obtained, is obvious: on the one supposition, that of their existing in simultaneous combinations, it is all that is to be done. On the other supposition, the statement affords the grounds on which the proportions of the binary compounds are inferred; and there can be no impropriety in adding the composition conformably to the products of evaporation. The results of the analysis of a mineral water may always be tested, then, in these three modes:—

1. The quantities of the acids and bases.
2. The quantities of the binary compounds, as inferred from the principle that the most soluble compounds are the ingredients; which will have, at the same time, the advantage of exhibiting the most active composition which can be assigned, and hence of best accounting for any medicinal powers the waters may possess.
3. The quantities of the binary compounds, such as they are obtained by evaporation, or any other direct analytic operation. The results will thus be presented under every point of view.

The above mode of analysis is applicable to those waters whose composition is the most complicated. It will therefore be modified according to circumstances. Thus, if for instance, there be no lime, the oxalate of ammonia need not be used, &c.

APPENDIX II.

ON THE MODE OF COLLECTING, PRESERVING, AND PACKING ANIMALS, PLANTS AND MINERALS.

It often happens that the countries over which a traveller journeys present many interesting objects belonging to the three kingdoms, which it is desirable to obtain and preserve; we shall give some instructions upon this subject, which we hope may prove acceptable.

We will remark, in the first place, that unless the traveller

occupy himself exclusively with Zoology, Botany, or Mineralogy, it will be almost impossible for him to procure in any considerable quantity the objects of these sciences, or to collect much exact information regarding them ; nevertheless, as the ordinary traveller, for whom the present work is particularly intended, may have frequent opportunities of obtaining objects of interest, we shall point out to him how to proceed.

ANIMAL KINGDOM.

Of animals, there are some which it may be desirable to obtain and preserve alive, as for instance, 1st, those quadrupeds whose wool or hair may be advantageously employed in the fabrication of stuffs, and which the traveller may therefore be desirous of naturalizing in his own country, in order to free it from a foreign dependence. 2nd, Animals of a kind similar to those of the traveller's own country, but of a superior breed, and which he would therefore procure for crossing. 3rd, domestic fowls whose flesh is delicate, nutritious, and wholesome, &c. There are others again, which, though dead, it may be desirable to have. Both the living and the dead animals may be procured either by hunting them oneself, or by purchasing them from the natives of the country.

With regard to such wild animals as it is wished to obtain alive, it is necessary to be acquainted in the first place, to a certain degree, not only with their particular haunts, but also with their habits, in order to know what kind of snares to set for them, in what places, at what particular season, at what hour of the day or night, &c. Information on this subject must be obtained from the inhabitants of the country who are most accustomed to see them, who know them, and who are accordingly the most likely to point out the best way of taking them. But if the country be but thinly inhabited, or if the inhabitants have never hunted or taken the desired animals, then the traveller will have recourse to his own resources, and contrive such snares as he thinks most likely to be successful.

When by any means the animals are secured, which it is wished to keep alive, care must be taken to keep them as much as possible in a temperature similar to that of their native climate, and to feed them with the kind of food to which they have been accustomed. They should, if possible,

be taken young as they are then more tractable, more easily naturalized to a new climate, accustom themselves more readily to a change of diet, and promise, moreover, all the advantages to be derived from a longer possession of them.

As for animals in general, whether quadrupeds, birds, fish, insects or reptiles, which it is desirable to have dead for the purpose of stuffing or otherwise preserving for cabinets of natural history, care should be taken to procure the most perfect specimens possible of each kind; and whenever a difference of age or sex causes any remarkable variety in the appearance of the animal, either by the development of new organs, by change of colour or otherwise, it would be well to procure as many individuals of each kind as is necessary for furnishing examples of their varieties or changes.

The best mode of procuring them will be that which injures them least. A musket-ball does less injury to the skin than a spear, a sword, or a hunting knife. Arrows are also good, if a single one ensures death; but a ball is more certain in its effect, hence the animal struggling less in his pangs, his skin sustains less injury. Animals taken in snares sometimes injure their furs to such a degree in their efforts to escape, as to render them useless when taken, at least inasmuch as their beauty is concerned. Poison may sometimes be employed, provided it be prompt in its effects, and not likely to endanger the lives or health of those who have afterwards to handle them and take off their skins.

For animals of small dimensions, shot of various sizes, according to circumstances, may be used. Birds may also be taken by means of bird-lime, or stupifying them at night, by burning sulphur under the branches where they roost. The clay balls thrown from the double stringed bow by a practised hand, kills birds without injuring their skins or feathers, or if they do not kill, generally so stun the bird that he may be taken alive. The writer has obtained many birds in this way. The bow is easily made, and the balls may be prepared wherever there is clay.

Fish are taken by the harpoon, by line and hook, by nets, and by snares of various construction, according to the kind of fish and other circumstances. The less they flounder about, the less do those which have scales lose any of their brilliant armour. As for winged insects, they are taken by means of a gauze net or deep cap fixed to a ring at the end of a long handle, or by means of what is technically called clappers; a kind of large pincers with gauze discs.

The most proper time for seeking for and taking the several objects must be discovered, or ascertained by inquiry of the natives.

On starting for the chase, for fishing, or for an entomological excursion, the traveller must be provided with all the necessary apparatus. There is this difference between a fishing and a shooting excursion, that the former is more exclusive. It is true that different fishing operations may be carried on at the same time, but little else can be attended to. Thus, lines or snares may be set in one place, while the fishers cast their nets, or fish with the harpoon, or with the rod and line in another part; but their fishing demands their whole attention. It is otherwise in a shooting excursion. The party must be prepared for every thing they may meet, large and small game, wild beasts and insects. Each individual should have a double barrelled gun. One barrel loaded with ball and the other with shot. It is advisable before starting to have all the charges, both ball and small shot, made up into cartridges and carried in a proper cartridge box. In this way the ammunition takes up less room, and the gun is loaded incomparably quicker. In a country where wild beasts are numerous and fierce, it is well to be also provided with pistols and a hunting knife. Prudence also dictates the propriety, in such cases, of being always accompanied, and this one generally is, if only by the servant or guide, who helps to bring home the spoils of the chase, and who carries the provisions and spare arms, among which it is not amiss to have a spear. Savages generally have their own arms. The provisions should take up little room, and consist of such things as are most proper to recruit the strength. The attendant should also carry paper, cotton, linen rag, and some dry absorbing powder.

As soon as a bird is shot, the wound should be powdered over to staunch the blood. This is done by raising up the feathers with a pin; a little cotton or rag is then inserted into the beak, the blood spilt is then gently wiped off from the feathers which are carefully disposed in their natural position. The bird is then laid on the ground to give the blood time to coagulate, after which it is put into a *cornet* of paper head foremost, holding it by the feet and tail. The paper is then closed and the bird placed carefully in a box with *dry* moss or leaves. Large birds after being put into paper may be further wrapped in tow, lightly secured with twine from head to foot, and then slung at the end of a stick carried over the shoulder by the attendant.

When birds have been taken by bird-lime, unless it be wanted to keep them alive, they must be killed without delay, taking care not to injure their plumage.

In the summer, or in hot climates, all animals should be skinned as soon as possible.

As for insects they should be killed at once by pressing the stomach between the thumb and forefinger or otherwise, and then fixed by means of pins at the bottom of a shallow box made for the purpose and with a bottom of cork. For butterflies, moths, grasshoppers, bees, &c., the pin should pass through the thorax, whereas for the coleoptera the pin should be inserted near the origin of the elytra, so that it may pass underneath between the first and second pair of legs.

Caterpillars may be placed together in a tin box having small holes and containing moss. If it be desirable to keep them for the sake of the butterflies or moths which they may change to, (and it is hardly possible to get the latter but by this means,) they should be placed separately, with a sufficient quantity of the leaves on which they feed. On reaching quarters they should be placed in larger boxes with earth at the bottom, (this precaution is necessary, as many caterpillars enter the earth in order there to assume their crysalis form,) each kind separately, with some small branches of the plant they were found upon, steeping the inferior extremities of these in water to keep them fresh, and allowing their leaves to touch the sides of the box so that the caterpillars may crawl from the bottom to their food or go down to the earth when they like. Fresh food should be supplied as often as is necessary. These boxes should have a hole at top covered with gauze, and a similar hole at the side will enable the observer to see what is going on. Caterpillars of the Zygænæ tribe of phalenæ are distinguished by a kind of horn on the upper part of the posterior rings of the body.

As it is not the object of the traveller to stuff and mount the various animals, birds, &c., which he may collect, we shall give no directions for these operations. Mounted animals take up a great deal of room and are spoiled in travelling. The principal object then is to preserve the skin, the head and feet, for this purpose they must be flayed, which is done by means of scalpels and pincers. The head and feet are left adhering to the skin, taking care to clear away as much of the flesh as possible from the latter, and to pick

out all the brains from the former. If the animal be very rare, it will be well to clean the skeleton and to preserve it together with the skin. It is not necessary to mount the skeleton, but none of the bones should be wanting or broken.

We shall now pass on to the mode of preserving and packing the several objects.

Strickly speaking, all animals of a certain size and even the smallest, with the exception of papilionaceous insects, may be preserved in glass jars and bottles, or casks, with alcohol. Indeed, for insects, reptiles, small fish, and small quadrupeds, this, is the best mode. Where the animals are too large for this, nothing but the skins and heads and feet should be kept. Of large fish, the skins only should be kept, taking great care not to injure the head or fins.

Alcohol for preserving animals should not be too strong, as when it is, it destroys the colours. Rum and arrack will do, but colourless spirit is preferable.

The animals should be suspended in the liquor, without touching the bottom, by means of a string fixed to the cork or stopper. They should be well cleaned externally before immersion, and a small incision made in the abdomen that the spirit may penetrate into the interior.

Several objects may be put into the same jar, but each separately suspended, and so as not to touch, if possible. Square bottles are the best, because they are easily packed in cases and take up less room. After the objects have been some time in the liquor, it is necessary to replenish the bottles, and then close them hermetically with a good cork and a luting, of which this is the composition recommended:—

Rosin.
Pulverized red ochre.
Yellow wax.
Oil of turpentine.

The proportions vary according as it is required to have the lute more brittle or more elastic.

Begin by melting the wax, then add the ochre in small quantities, turning the whole rapidly the while with a spatula. After this mixture has boiled seven or eight minutes, the oil of turpentine must be poured in, mix up and continue to boil. Care must be taken to use a pot capable of containing three times the quantity of stuff to be prepared, in order to prevent its taking fire. The tenacity of the lute is tried by putting a little now and then on a cold plate.

Having corked and well wiped the bottle, twist a bit of rag round the end of a stick, and with this daub over the cork and neck of the bottle with the boiling composition. Two or three layers are requisite, waiting each time till the coating last laid on be cold. The bottle must then be covered with a piece of linen steeped in pitch and well secured with twine. Finally the bottles are packed in cases.

When it is required to preserve the skins dry, they must be internally rubbed over with a brush steeped in petroleum or spirits of turpentine, and then placed, together with some cotton impregnated with the same substances, in a box and well closed. For want of petroleum or turpentine, a decoction of butter and aromatic herbs may be used for washing over the inside of the skin. After which they should be powdered with tobacco, pepper, and other spices. The skins of birds should be lightly stuffed with cotton, not for the purpose of giving them any form, but in order to prevent the different parts of the skin from sticking together. Each is then wrapped separately in paper. When they are to be packed it must be done carefully, and the boxes of dried skins must be well coated with pitch, that no moisture may penetrate them.

There are certain objects of the animal kingdom that require particular care, as the star fish, echinites, zoophites, &c. But we are compelled to leave this and much more to the sagacity of our readers in order not to swell our volume, already much more bulky than we had anticipated. We recommend for further details on Taxidermy the works of Réaumur, of Schoeffer, of the Abbé Manése, of Du Fresne, of Nicolas Desmoulins, Maugé, &c.

The traveller should procure, if possible, the nests of birds together with the eggs: there are, however, nests which cannot be taken away, in which case it will be sufficient to describe them. As for the eggs, they should be emptied by making a hole at each end with a pin and blowing out the contents, and then injected with white wax, and packed in cotton. Perhaps, by boiling them hard and covering them with a transparent varnish they may be easily transported and will keep a long while.

Great care must be taken to label every object distinctly, and to accompany it with a detailed notice, such as we have pointed out in our article on Animal Productions.

VEGETABLE KINGDOM.

Objects of the vegetable kingdom are usually preserved in a *Hortus Siccus.* Plants that are not too large may be put in whole, unless the roots are bulbous or too thick. In some cases the roots may be slit, and only one half preserved. Of plants that are too high to be put into the herbarium, the upper part only may be taken, or, if the root be not too thick, it may be cut off altogether above the collar, and even slit, if necessary ; then put up together with the upper part of the plant.

The most perfect individuals should be chosen, and when in flower if possible.

When herborizing, a basket should be carried about twenty inches long, ten wide, and eight deep, having a flat detached lid of such size as to enter freely into the basket, and which may be fixed at any required height by means of wooden skewers running through the basket from side to side, and passing over the lid. This basket should be carried by a strap crossing crosswise over the right shoulder, into it the plants are to be laid carefully as they are collected. When too long to enter with their roots, if these are to be preserved they must be cut off above the collar or neck, as just directed, and tied to the lower part of the stem with a little packthread. The more delicate plants should be laid uppermost. Mosses should be wrapped up, each kind by itself, in soft paper or linen, and placed in the basket, at the root end of the plants.

As plants flower at different seasons, some may be met with that are in seed. If the traveller does not remain long enough on the spot to see the plant flower again, he will take it as he finds it, or at least the seed with its capsules, pods, or other envelop, and put it in paper. This precaution of wrapping plants in seed in paper, is equally necessary when the whole plant, or head of the plant be taken, otherwise the seeds will get lost or mixed with those of other plants in carrying home. It is hardly necessary to add, that whenever a plant and its seed are taken separately, care must be taken not to forget to which plant each kind of seed belongs. Nuts should also be put up in paper. Fleshy and tender fruits should be first wrapped in paper, then in moss or tow.

To each separate object a number must be attached corresponding to a similar number in the note book, the notes, being always entered upon the spot, must state whether the object belong to a tree, a shrub, a creeping plant, an aquatic, or otherwise, where it was found, in what kind of soil, what aspect, the date and the hour of the day, whether the flower was opened or closed. The detailed description should be given in the way indicated, section VEGETABLE PRODUCTIONS.

With regard to large trees, no part of them can be taken but the leaves, the flowers, and the fruit. Sometimes even these cannot easily be transported by reason of their size, as the leaves of the Talipot and other palms, the fruit of the Jack tree, &c. But when the moderate size of the objects permit, the leaves should be put into the *hortus siccus*, and the fruit into paper or spirits, according to its nature. It is also very desirable, if possible, to obtain slices of the wood of trees, one cut horizontally (but only a sector of the disc when the tree is large) and one cut longitudinally, the breadth of which should be, for the smaller trees, from the centre to the circumference ; for the larger trees the longitudinal slice should be taken from the best part of the wood. It would be well also to take a portion of the bark, which is not unfrequently the most interesting part of the tree. Similar numbers should be fixed to all the portions of the same tree.

Wherever parasite plants are collected, a note should be made of the trees on which they were found, and parts of the tree itself should also be taken, and in preference, if possible, the part to which the parasite adheres. Observe also if the climbing plants climb round any particular tree in preference, and if so on which, or if they climb indifferently on the first support they meet. When such wind round a stem, observe if they turn with the sun or in a contrary direction. Very long portions of lianas may be taken and should be coiled up like a rope.

As for the mode of preserving,—small plants whole, and the leaves and flowers of the larger plants may be preserved in a *hortus siccus*, seeds and nuts in paper, fleshy fruits in spirits.

To form a herbarium the plants must be dried by laying them between sheets of unsized paper, and slightly pressing them at first in a press, or between the leaves of a large book, or between two planks, with a stone on the upper one.

After a day or two the papers should be changed, any deranged leaves or petals laid out properly and a greater pressure be given. The drying may be accelerated by placing the plants in this form in the sun, or near a fire, or in an oven from which bread has just been taken, or by placing the plants between two sheets of paper in dry hot sand, &c.

Thick flowers as that of the thistle, &c., may have one half cut away. Some vivacious plants continue to grow in the herbarium, to prevent which, their vitality might be destroyed by plunging them for a moment into boiling water before drying them. When the plants are perfectly dry they should be placed in other papers and arranged according to their natural order, or otherwise, with their names and the notes regarding them written on the paper itself; or a number may be affixed to the specimen corresponding to a number in a separate catalogue. The plants in their sheets should be put together and strapped firmly between two boards a little larger than the sheets.

Seeds, which should never be gathered, if possible, but when arrived at full maturity, or which should not be separated from their capsules or pods till these open with facility, or when the fleshy pulp which envelops them begins to rot, should be put up in paper bags, numbered externally, and having a corresponding number inside. The same may be said of nuts, which have no fleshy pericarpe.*

Fleshy fruits should be placed in little nets, each separately, and suspended in wide mouthed bottles, in spirits of wine. These bottles to be hermetically closed in the way we have already described, and then packed in well pitched dry strong boxes.

When it is required to have plants for cultivation, young plants or off-sets, according to the nature of the plant may be taken; where the plants cannot be propagated by seed, or when seed is not to be had. Seeds for propagating, if of an oily nature, which exposes them to lose promptly their generating faculty, should be put into a sandy earth. For this purpose put into the bottom of a box a layer of about two inches of light sandy soil. On this distribute the seeds at a distance from each other equal to their length; cover them over an inch thick with the same soil, on this place a second layer of seed, then soil, and so on till within an inch

* M. De Candolle recommends to pack in charcoal all seeds collected in a wet season or country.

of the top of the box; fill up this space with the same earth, taking care that the box be quite full; close the box, leaving a hole at top, for the circulation of air, which hole must be covered with a wire gauze to prevent rats, beetles, &c., getting in.

MINERAL KINGDOM.

The objects of the mineral kingdom are alkaline and earthy salts, clays, sands, tufas, volcanic ashes and cinders, combustibles, ores, animal and vegetable fossils, mineral waters, &c.

With regard to alkaline salts, they are, generally speaking, too well known to render it worth while to collect them unless they present some remarkable phenomena of mixture or crystallization. In preserving them, great care should be taken to secure them from moisture. They are best preserved in glass bottles with ground glass stoppers covered over with bladder. Of the earthy salts, the sulphate of alumina is generally met with only in small quantity, most frequently in the form of an efflorescence or in delicate scales. The fluate of alumina is very rare. The first of these being soluble must be kept very dry, the second being insoluble does not require the same precautions. The sulphate of magnesia demands the same attention to dryness as alumina when it is found as an efflorescence; it is also found in solution. The borate of magnesia, on the contrary, is absolutely insoluble in water. The nitrate of lime is met with in the form of an efflorescence and in silky tufts; it is very deliquescent and consequently requires to be well preserved from damp. The sulphate, carbonate, fluate, phosphate, &c., of lime, demand no particular precautions against damp. The same may be said of the sulphate and carbonate of barytes, and of the sulphate and carbonate of strontian. We have thus particularized the salts, as their name of salt might lead into error regarding them, those who are unacquainted with their nature. We shall speak generally of the other objects of the mineral kingdom.

All minerals are found either in an earthy form, or crystallized, or amorphous; some are hard and solid, others tender or friable. This difference in their nature requires a difference in the mode of collecting and packing. We shall first speak of the objects with which the traveller

should be provided when he starts upon a mineralogical excursion and the manner of using them. We will then point out the mode of packing the objects collected so that they may be easily transported to any distance.

The traveller should have a basket. His botanical one already described will do. In this must be placed several small rectangular tin boxes, about four inches long, three broad, and two deep: also a few round boxes of thin wood or pasteboard an inch in diameter and two inches deep. These boxes must shut well, particularly the latter, as they are destined for the earthy and friable minerals and efflorescences, which the slightest shaking reduces to powder, as is the case with certain Kaolins, Chalks, &c. Two or three thick phials for sand should be put into the basket, as also some cotton or tow, some tissue paper, and some soft and some coarse brown paper, and some packthread. A small phial with ground glass stopper ending in a prolonged point, and covered by a glass cap, and containing muriatic or nitric acid, should be fitted into a wooden case with a screw top and carried in the pocket. Besides the basket just mentioned and its contents, two hammers should be carried, a large and a small one: the first for detaching specimens from the rock, the latter for trimming them or for detaching the more delicate minerals. A mason's chisel and point will also be found very useful, in many cases; the chisel being of steel will answer for trying if the mineral emits sparks when struck upon this metal. A pocket thermometer should also be carried and a clinometer, the former for taking the temperature of any cave or spring that may be met with, and the latter for the dip and strike of the strata. A leather bag must also be carried for the heavier and coarser specimens. In the pocketbook should be taken some test paper and a sheet on which a series of numbers should be written before starting, say from 1 to 100, not that so great a number of specimens will be collected in one excursion, but it takes no room, and it is always better to have too many numbers than not enough.

Such is the equipment we recommend for going in search of minerals. If the explorer knows beforehand that he is going to visit caverns, climb perpendicular cliffs, &c., he will of course provide himself and party with ropes, candles, matches, &c.

When earthy, sandy, or friable minerals or efflorescences are met with, they must be collected with caution, taking

care not to take up with them, if possible, any foreign substance, such objects must be put into one of the wooden or pasteboard boxes, together with a number torn off from the series, and the box being wrapped in brown paper, should be returned into the basket. A memorandum must then be made on the spot, preceded by a similar number to that put into the box. These instructions regarding the number and note apply equally to every specimen collected, of whatever nature it may be.

As for crystals, they must be detached with care, using for that purpose the chisel or the point, or the small hammer, as may be most convenient. It is very advisable, if possible, to have a portion of the gangue or matrix adhering to the crystals. These crystals must be first wrapped with a number in tissue paper, then in cotton or tow, and put into one of the tin boxes if it will hold them, if not, they must be wrapped in brown paper, and tied and put in this manner into the basket. Delicate concretions, as the flos-ferri, thin hollow stalactites, &c., must be treated like crystals.

Soft clays may be put into the tin boxes, or wrapped in brown paper, then in tow, then in more paper and tied up, laying nothing heavy over them.

Hard amorphous minerals must be detached in pieces about four inches long, three wide, and two thick, taken in such a way as to have all the sides with a fresh fracture save one, which should show the effect of weathering. Specimens of this kind, roughly trimmed upon the spot to avoid the carriage of useless weight, must be wrapped up in paper, then in tow, and packed into the leather bag, always placing the lightest and most easily frangible at the top.

With regard to ores, fossils, &c., such as are delicate, must be treated as we have indicated for delicate crystals, great care should be taken in respect to fossils, not to break or injure them in taking them out of the rock. If they are difficultly separated from the matrix, take a portion of this with them rather than risk their breakage, indeed, in all cases of fossils, it is desirable to have a portion of the matrix adhering to them, or at least packed up with them, and if loose, a portion of the soil in which they are found.

When the basket is filled it may be closed in the way we have described. By taking care to be provided with the several objects above specified, much useless labour will be spared. By carrying a little muriatic acid, there is no risk of lugging a mass of stones, supposed to be salts, and which

perhaps, when found not to be so, have no interest. By trimming the specimens on the spot, their volume and weight is greatly reduced; a greater number of specimens may accordingly be taken, and if, in the trimming, the specimen gets broken, another may immediately be procured.

As for mineral waters, we have treated of them in the foregoing appendix. Sands should be put into the glass phials.

It only now remains to say a word on preparing and packing minerals for distant transportation. The only preparation required is, that the specimens of rock be reduced to the size we have mentioned. As for crystals, however large they may be, they must on no account be reduced; the same may be said of groups of crystals, which must be preserved entire if possible; that is, if their beauty and elegant or singular disposition render them deserving of such care.

Minerals must be packed in much the same way as that we have pointed out for bringing them home from the field; only greater care must be taken with the earthy minerals, which must be put into boxes that they will exactly fill, and, before the lids are put on, a piece of linen should be laid over each so to make the lid fit tight, and prevent the loss of any of the mineral in the form of a fine sand or powder. The little boxes must then be numbered and sewed up tight in coarse linen. Very delicate objects must each be packed separately, first in tissue paper, then in cotton or tow, and lightly fixed into boxes of a convenient size. The number of each specimen must accompany it. The rocks and hard stones must be wrapped in three successive papers, first, tissue paper, then soft brown paper with the number, lastly, coarse brown paper and tow.

The whole must now be packed in strong wooden boxes of convenient size, with tow at bottom, putting the heaviest in first, and fixing the whole so tightly that nothing shall move or get deranged.

If tow cannot be procured, dry moss will do, or anything else of like kind. The box being filled, it must be well screwed down, pitched, and then wrapped in coarse oilcloth strongly corded and kept dry, and out of danger from accidents.

As for the notes which should accompany the minerals they should be very explicit, and embrace the several objects we have pointed out in treating of the observations to be made on the Mineral Productions of a Country.

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